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IN THEIR RELATION TO PLANT DISEASES.

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EXPERIMENTS IN THE TREATMENT OF RUSTS AFFECTING WHEAT AND OTHER CEREALS.

By B. T. Galloway.

INTRODUCTION.

No plant diseases have attracted as widespread attention as the rusts of cereals. For more than a hundred years scientists and practical men all over the world have made these parasites the subject of study and thought, but as yet nothing definite is known as regards a practical and efficient means of preventing them. At the present time the rust of wheat is probably attracting more attention in Australia than any other country. The whole colony is alarmed at the ravages of the rust pest, which, it is estimated, causes a loss of over $10,000,000 annually. At a recent rust conference held in Sydney,* delegates were present from Victoria, South Australia, Queensland, and New South Wales. Some knowledge of what was done at this gathering may be gained when it is stated that it lasted five days and that the report of its proceedings embodies over fifty thousand words. The delegates were a representative body of men, and the report shows them to be thoroughly conversant with nearly all known facts bearing upon this important subject. In this country rust has of late attracted no great amount of attention. This is not due to a diminution in the amount of damage it occasions, but is owing to the fact that the annual drain upon the farmers' income, which it causes, has come to be regarded as a matter of course. Year after year the crop in nearly every field is cut short by rust, so that it is difficult to say just how much damage results simply because there are no figures for comparison.

The average yield of wheat in the United States in 1891 was only 15.3 bushels per acre,† an amount insignificant when compared with some countries that do not have half the natural advantages. This abnormally low yield is, of course, due to several causes, rust being

* A review of the report of this conference is to be found on another page of this Journal.

† Report U. S. Department of Agr., 1891, p. 29.

one of them. By better methods of farming, such as the improvement of varieties, crop rotation, the prevention of rust and smut, proper use of plant foods, etc., the average yield could in all probability be raised to 20 bushels per acre at comparatively little additional expense. Such an increase would mean to our farmers more than $170,000,000, annually. The rust problem, so far as it concerns the yield of grain, probably exerts as great an influence as any one thing over which there is a possibility of control. It is important, therefore, that all phases of the subject be fully investigated as it is by this means only that proper conclusions in regard to prevention can be reached.

PLAN OF THE WORK.

In planning the work on rust it seemed desirable at first to limit the investigations to two lines of research. These may be briefly summarized as follows:

(1) Experiments in spraying with various chemicals and in treating the soil and seed in various ways in the hope of preventing the disease.

(2) Comparative studies of several so-called rust-resisting and non-rust-resisting varieties, to determine whether they possess more or less constant anatomical or physiological characteristics which may explain susceptibility or nonsusceptibility to the disease.

This paper, as the title indicates, will deal with the first problem, *i. e.*, experiments in spraying and in soil and seed treatments to determine their effects on rust. At the outset it was decided to make an attempt to prevent rust without any special regard to expense, it being thought that the latter question could be considered later as a distinct problem. It is proper here to acknowledge the valuable assistance rendered by W. T. Swingle, P. H. Dorsett, and D. G. Fairchild. The experiments would doubtless have been largely under the supervision of Mr. Swingle but for the fact that more immediately important labors called him elsewhere. With but one exception all the treatments at Garrett Park, Md., were made by Mr. Dorsett. He also collected the specimens at each treatment, made the many necessary tedious counts of plants, and harvested and threshed the grain. Mr. Fairchild aided materially in making out the formulæ for fungicides and also assisted in other lines of work.

In order that the work might be carried on under as widely different conditions of soil and climate as possible, Maryland and Kansas were selected as the States in which to make the experiments. In Maryland the work was carried on under the supervision of the writer, while in Kansas a part was intrusted to J. F. Swingle, of Manhattan, and a part to E. Bartholomew, of Rockport, 160 miles northwest of the former place. The experiments at the three stations were in most respects similar, but for the sake of convenience they will be described under separate heads.

Before taking up the experiments in detail, it may be said that they were designed primarily to determine—

(1) The effect on winter wheat of treating the soil with various chemicals before planting.

(2) The effect of treating the seed, previous to planting, with chemicals and with hot water.

(3) The effect of spraying and dusting the plants every ten days from the time they appeared above ground until harvest, using various preparations having known fungicidal value and others that had never been tested in this respect.

(4) The effect of spraying and dusting every twenty days, beginning and ending the same as in (3), and also using the same preparations.

(5) The effect of spraying and dusting the plants every ten days, combined with soil treatment alone and with both soil and seed treatments.

(6) The effect of spraying and dusting every twenty days combined with the other treatments, as in (5).

(7) The effect on spring-planted wheat, oats, and rye of spraying and dusting with various fungicides and other preparations at intervals of two, ten, and twenty days, respectively.

From the foregoing it will be seen that there were soil and seed treatments; spraying and dusting at intervals of two, ten, and twenty days; and a combination of these various methods. In all cases it should be borne in mind that the word "effect" is here used in a broad sense, that is, it includes the influence of the various treatments on rust, as well as on the soil, seed, and plants. The foregoing general summary of the objects of the work will, it is hoped, enable the reader to understand the details which will now be taken up.

EXPERIMENTS AT GARRETT PARK, MARYLAND.

For the work at this place a piece of ground 400 feet long and 110 feet wide was selected. It was comparatively level, and as regards fertility and other necessary important conditions, was fairly even throughout.

On September 20, 1891, the ground was plowed and thoroughly harrowed, but owing to the fact that for several years it had been in clover it was with difficulty put in good condition for planting. On October 5 it was platted, the plats throughout being 3 feet wide and 33 feet long. Walks 2 feet wide were left between each plat, and alleys 3 feet wide were run every 33 feet from end to end of the entire block. Planting began on October 14 and was finished on the 25th of the same month. Every plat was planted by hand, the grain being sown at the rate of 2 bushels per acre in drills 9 inches apart. The drills were opened with a hoe, and after sowing the grain was covered with the same implement. The following is a list of the various treatments, set forth in tabular form.

TABLE 1.—*Statement of the method of treating each plat in the wheat-rust experiments at Garrett Park, Md.*

SERIES I.—SOIL TREATMENT.

Plats.	Kind of treatment.
1 and 91	Untreated.
2 and 92	Soil treated with flowers of sulphur, 4 ounces to each 20 feet of row.
3 and 93	Untreated.
4 and 94	Soil treatment with flowers of sulphur, 2 ounces to each 20 feet of row.
5 and 95	Untreated.
6 and 96	Soil treatment with flowers of sulphur, 1 ounce to each 20 feet of row.
7 and 97	Untreated.
8 and 98	Soil treatment with flowers of sulphur and air-slaked lime, equal parts mixed, 4 ounces to each 20 feet of row.
9 and 99	Untreated.
10 and 100	Soil treatment with flowers of sulphur and air-slaked lime, equal parts mixed, 2 ounces to each 20 feet of row.
11 and 101	Untreated.
12 and 102	Soil treatment with powdered ferrous sulphate, exsiccated, 4 ounces to each 20 feet of row.
13 and 103	Untreated.
14 and 104	Soil treatment with solution of ferrous sulphate, 8 ounces to 1 gallon of water, sprayed on the ground at the rate of ½ gallon to each 20 feet of row.
15 and 105	Untreated.
16 and 106	Soil treatment with ½ gallon of Bordeaux mixture to each 20 feet of row.
17 and 107	Untreated.
18 and 108	Soil treatment with ½ gallon of water containing ½ ounce of potassium sulphide (liver of sulphur) to each 20 feet of row.
19 and 109	Untreated.
20 and 110	Soil treatment with ½ gallon of ammoniacal solution of copper carbonate to each 20 feet of row.
21 and 111	Untreated.
22 and 112	Soil treatment with ½ gallon of Bordeaux mixture to each 20 feet of row.
23 and 113	Untreated.
24 and 114	Soil treatment with a solution of potassium bichromate 1½ ounces in 13½ quarts of water, sprayed on the entire plat.
25 and 115	Untreated.

SERIES II.—SEED TREATED BY IMMERSION.

26 and 116	Seed treatment, immersed for 15 minutes in water at a temperature of 132½° F.
27 and 117	Untreated.
28 and 118	Seed treatment, immersed for 24 hours in an 8:100 solution of copper sulphate, then limed.
29 and 119	Untreated.
30 and 120	Seed treatment, immersed for 24 hours in Bordeaux mixture.
31 and 121	Untreated.
32 and 122	Seed treatment, immersed for 24 hours in potassium bichromate, 5:100 solution.
33 and 123	Untreated.
34 and 124	Seed treatment, immersed for 24 hours in a solution of potassium sulphide (liver of sulphur), 1 ounce to 1 gallon of water.
35 and 125	Untreated.
36 and 126	Seed treatment, immersed for 24 hours in a solution of potassium sulphide (liver of sulphur), ½ ounce to 1 gallon of water.
37 and 127	Untreated.
38 and 128	Seed treatment, immersed for 24 hours in a 1:1000 solution of corrosive sublimate.
39 and 129	Untreated.

SERIES III.—PLANTS SPRAYED AND DUSTED.

40 and 130	Plants sprayed every 10 days, from the time they appeared above ground, with Bordeaux mixture.
41 and 131	Untreated.
42 and 132	Plants sprayed every 10 days, from the time they appeared above ground, with ammoniacal solution of copper carbonate.
43 and 133	Untreated.
44 and 134	Plants sprayed every 10 days, from the time they appeared above ground, with a solution of potassium sulphide, 2 ounces to 3 gallons of water.
45 and 135	Untreated.
46 and 136	Plants sprayed with Bordeaux mixture every 20 days.
47 and 137	Untreated.

TABLE 1.—*Statement of the method of treating each plat in the wheat-rust experiments at Garrett Park, Md.*—Continued.

SERIES III.—PLANTS SPRAYED AND DUSTED—Continued.

Plats.	Kind of treatment.
48 and 138	Plants sprayed every 20 days with ammoniacal solution of copper carbonate.
49 and 139	Untreated.
50 and 140	Plants sprayed every 10 days with cupric ferrocyanide mixture.
51 and 141	Untreated.
52 and 142	Plants sprayed every 10 days with ferrous ferrocyanide mixture.
53 and 143	Untreated.
54 and 144	Plants sprayed every 10 days with copper borate mixture.
55 and 145	Untreated.
56 and 146	Plants sprayed every 10 days with ferric chloride solution.
57 and 147	Untreated.
58 and 148	Plants dusted every 10 days with flowers of sulphur.
59 and 149	Untreated.
60 and 150	Plants dusted every 10 days with sulphosteatite.

SERIES IV.—MISCELLANEOUS TREATMENTS.

61 and 151	Untreated.
62 and 152	Complete treatment with Bordeaux mixture; seed immersed 24 hours; plat sprayed before planting with 13½ quarts and plants sprayed every 10 days.
63 and 153	Untreated.
64 and 154	Complete treatment with potassium sulphide solution, 2 ounces to 2 gallons of water; grounds sprayed and plants sprayed every 10 days.
65 and 155	Untreated.
66 and 156	Seed immersed for 15 minutes in water at 132½° F.; ground sprayed with ammoniacal solution and plants sprayed every 10 days with the same preparation.
67 and 157	Untreated.
68 and 158	Seed immersed for 15 minutes in water at 132½° F.; soil treated with Bordeaux mixture and plants sprayed every 10 days with the same preparation.
69 and 159	Untreated.
70 and 160	Seed immersed for 15 minutes in water at 132½° F.; soil treated with lime and sulphur, equal parts mixed, at the rate of 4 ounces to 20 feet of row.
71 and 161	Untreated.
72 and 162	Seed immersed for 15 minutes in water at 132½° F.; soil treated with ferrous sulphate at the rate of 2 ounces to 20 feet of row.
73 and 163	Untreated.
74 and 164	Seed, soil, and plants treated with ferrous sulphate; seed immersed 24 hours in a 10 : 100 solution; soil sprayed before sowing and plants sprayed every 10 days with 4 ounces to 1 gallon of water.
75 and 165	Untreated.
76 and 166	Seed immersed in ammoniacal solution 24 hours; plants sprayed every 10 days with the same preparation.
77 and 167	Untreated.
78 and 168	Soil treated with common salt at the rate of $\frac{1}{10}$ ounce to 10 feet of row.
79 and 169	Untreated.
80 and 170	Soil treated with salt at the rate of $\frac{1}{20}$ ounce to 20 feet of row.
81 and 171	Untreated.
82 and 172	Soil treated with copper sulphate solution, 13½ ounces to 13½ quarts of water per plat.
83 and 173	Untreated.
84 and 174	Plants sprayed with cupric hydroxide mixture every 10 days.
85 and 175	Untreated.

THE FUNGICIDES AND OTHER PREPARATIONS USED IN SPRAYING AND DUSTING THE PLANTS.

Nine solutions and two powders were used in the spraying and dusting experiments. They were as follows:

(1) Bordeaux mixture.

(2) Ammoniacal solution of copper carbonate.

(3) Ferrous ferrocyanide mixture.

(4) Copper borate mixture.

(5) Ferric chloride solution.

(6) Ferrous sulphate solution.
(7) Cupric ferrocyanide mixture.
(8) Cupric hydroxide mixture.
(9) Potassium sulphide solution.
(10) Flowers of sulphur.
(11) Sulphosteatite powder.

Numbers 1, 2, 5, 6, 9, 10, and 11 were all preparations of more or less known fungicidal value. Numbers 3, 4, 7, and 8, prepared as below described, had, so far as known, never been used in combating parasitic fungi affecting plants.* Below are set forth the formulæ of the various solutions and powders, the amount given in every case being that used per plat at each treatment:

(1) *Bordeaux mixture.*

Cupric sulphate	5.22 grams	0.184 ounce.
Lime (stone)	1.26 grams.	0.044 ounce.
Water	7,572 grams	2 gallons.

The cupric sulphate was dissolved in about a pint of water; the lime was then slaked in a separate vessel, enough water being added afterwards to make a thick whitewash. This was poured into the cupric sulphate solution and enough water added to make 2 gallons. Usually an excess of the lime milk was made up and just enough added to the copper solution to precipitate all of the cupric hydroxide. The presence of copper sulphate in solution, which always indicates an imperfect preparation, was determined by means of a 5 per cent solution of potassium ferrocyanide. A few drops of this solution, when added to the Bordeaux mixture gives a brownish red precipitate if copper sulphate in solution be present. If the reaction has been perfect no change whatever occurs.

(2) *Ammoniacal solution of copper carbonate.*

Copper carbonate	2.34 grams	0.082 ounce.
Aqua ammonia (26°)	50 cc	1.68 ounces.
Water	7,572 grams	2 gallons.

The copper carbonate was first mixed in sufficient water to form a thick paste; the ammonia was then added and the resulting liquid was diluted with 2 gallons of water.

(3) *Ferrous ferrocyanide mixture.*

Ferrous sulphate (exsiccatus)	3.44 grams	0.192 ounce.
Potassium ferrocyanide (yellow prussiate of potash).	9 grams	0.518 ounce.
Water	7,572 grams	2 gallons.

* Lodeman, in Bull. No. 35, N. Y. Cornell Ag. Ex. Sta., used copper borate, but only as a commercial article, suspended in water.

The ferrous sulphate and potassium ferrocyanide were dissolved separately, a pint to a pint and a half of water being used in each case. When the two chemicals were completely dissolved they were poured together and enough water added to make 2 gallons. Prepared in this way the solution is of a blue black color.

(4) *Copper borate mixture.*

Cupric sulphate	5.22 grams	0.184 ounce.
Borax (sodium borate)	13.00 grams	0.458 ounce.
Water	7,572 grams	2 gallons.

This solution was prepared in exactly the same way as the last. It was pale blue in color and could scarcely be seen when applied to the leaves of plants.

(5) *Ferric chloride solution.*

Ferric chloride	0.24 gram	0.254 ounce.
Water	7,572 grams	2 gallons.

The ferric chloride was simply mixed with water, the resulting solution being of a deep orange color.

(6) *Ferrous sulphate solution.*

Ferrous sulphate (exsiccatus)	30.42 grams	1.073 ounces.
Water	7,572 grams	2 gallons.

A simple solution made by dissolving the ferrous sulphate in water.

(7) *Cupric ferrocyanide mixture.*

Cupric sulphate	5.22 grams	0.184 ounce.
Potassium ferrocyanide	11.90 grams	0.4197 ounce.
Water	7,572 grams	2 gallons.

The cupric sulphate and potassium ferrocyanide were dissolved separately, each in about a pint and a half of water. When poured together a thick paste-like, chocolate-brown precipitate is formed. This, when diluted with water gives a walnut-brown mixture.

(8) *Cupric hydroxide mixture.*

Cupric sulphate	5.22 grams	0.184 ounce.
Potassium hydrate	2.34 grams	0.082 ounce.
Water	7,572 grams	2 gallons.

This was prepared similarly to Bordeaux mixture, which it resembles somewhat in color and chemical composition.

(9) *Potassium sulphide solution.*

Potassium sulphide (liver of sulphur)	28.34 grams	0.999 ounce.
Water	7,572 grams	2 gallons.

The potassium sulphide was dissolved in the water and sprayed on the plants at once to avoid the chemical change which quickly takes place when the solution is allowed to stand exposed to the air.

(10) *Flowers of sulphur.*

The commercial article was used in the dry form.

(11) *Sulphosteatite.*

This preparation was furnished by C. H. Joosten, of New York. It is a fine greenish powder, consisting of 9 parts of steatite or talc and one part of finely-powdered copper sulphate.

The ammoniacal solution of copper carbonate, containing 2 ounces of copper carbonate dissolved in 1 quart of ammonia and diluted with 22 gallons of water was used as a basis in preparing numbers 1, 2, 4, 7, and 8 of the foregoing. Numbers 3, 5, and 6, containing iron, were double the strength of the copper preparations. As near as possible, therefore, plats treated with preparations 1, 2, 4, 7, and 8 received 1.32 grams of copper at each treatment, while plats treated with 3, 5, and 6 received 2.64 grams of iron. It will be seen that in comparison with the well-known fungicides all the preparations were very weak, the Bordeaux mixture being less than one-fortieth the standard strength.

A preliminary test was made of all the foregoing preparations, with the exception of numbers 10 and 11, to determine (1) their adhesiveness and (2) their power to wet the foliage. By adhesiveness is meant the resistance to removal by rain or dew. Power to wet the foliage really means an even distribution over the entire surface of the leaf. It was found after nearly a month's work on oats, rye, wheat, and barley that no matter in what manner the solutions were applied, with the possible exception of rubbing them on with the hand, none would spread out in a thin film over the leaf surface. When applied with an ordinary improved Vermorel nozzle the liquids would simply strike the leaf and roll off in drops. By using a large atomizer, thereby increasing the fineness of the spray, it was found possible to wet the leaves still more, but the result was far from satisfactory. Various substances, such as glue, gum arabic, molasses, honey, and milk were added to the preparations in the hope that they would increase their wetting properties. Milk was found to be fairly satisfactory, but was discarded on account of expense. None of the other substances proved of value. Finally soap, which at the time we were not aware had before been used, was tried and was found to give better results than anything hitherto employed. After testing various brands, the Ivory soap was selected as the best suited to our wants. It was accordingly used throughout the experiment, combined with all the preparations except ferrous sulphate and ferric chloride solutions; these refused to unite with the soap, and consequently they were applied without it. After a number of trials the following method of using the soap was adopted:

Seven 5-cent bars of Ivory soap were shaved up by means of a small

plane. The shavings were placed in a tin watering can and about 1 gallon of water added. The can was then placed on a small oil stove and slowly heated until the soap was dissolved. When completely dissolved, 1 quart of the liquid, or about one-fourth of the contents of the can, was added to each solution. A complete mixture was affected by pumping the liquid back into itself, using a small hand pump for the purpose. In every case the soap readily mixed with the solutions, forming a frothy, slimy fluid which dispersed itself over the leaf in a fairly satisfactory manner. It may be well at this point to explain why it is so difficult to wet the foliage of wheat, oats, and allied plants. A microscopic examination of the leaves, sheaths, and culms in many cases reveals the fact that they are covered with an exceedingly thin layer of granular wax, which not only prevents the entrance of water to the tissues from without, but also probably acts as a check to transpiration. The wax undoubtedly protects the plants in other ways, but of these and similar questions bearing on the same subject it is unnecessary to speak here.

METHODS OF APPLYING THE LIQUIDS AND POWDERS.

The liquids were all applied with a small double-acting force pump which has been used by the Division for several years in spraying experiments. The pump was provided with a Vermorel nozzle attached to a lance 2½ feet long. The lance in turn was attached to the pump by means of a piece of ¼-inch cloth insertion hose 4 feet long. The solutions were prepared in a 3-gallon bucket and sprayed from it directly upon the plants. With this apparatus a plat, even after the wheat was nearly grown, could be thoroughly sprayed in three minutes. The powders were applied part of the time by hand and part of the time with a small hand bellows. In the soil treatments the fungicide was sprayed or dusted into the bottom of the drills and the seed planted directly upon it.

Having now considered the questions of a general nature connected with the work, the detailed observations made at the time of the various treatments may be taken up.

DETAILED OBSERVATIONS ON THE TREATMENTS.

First treatment (*November 14, 1891*).—The plants at this time were from 2 to 4 inches high and showed no signs of rust or any other disease. In some of the soil and seed treatments the grain had not sprouted. It was decided, however, to make no observations on any of these plats until it was plainly apparent that the seed was killed. A careful examination of all the plats sprayed and dusted revealed the fact that potassium sulphide was the only preparation that had injured the foliage. The tips of the leaves sprayed with this chemical were, in nearly every case, whitened and shriveled. As regards the wetting power of the various preparations it may be stated that the ferrous

ferrocyanide mixture was the only one that gave anything like satisfactory results. It formed a thin film, which covered both sides of the leaves fairly well. The tendency of all the preparations, with the exception of the foregoing, was to collect in drops, and if these attained sufficient size their own weight would cause them to roll from the leaf. The inability to wet the foliage was markedly present in the case of the plats treated with Bordeaux mixture. Ammoniacal solution was somewhat better in this respect, but not so good as the copper borate and cupric ferrocyanide mixtures. Ferric chloride solution did not show on the leaves at all, nor was it possible, except in rare instances, to distinguish the ferrous sulphate on the foliage. Sulphur and sulphosteatite showed plainly at first, but a breath of wind or a little rain or dew was sufficient to remove all traces.

Second treatment (*November 25, 1891*).—No marked change had taken place in the growth of the plants since the last treatment. Some were beginning to stool and others were just pushing through the soil, showing that the seed was somewhat irregular in germinating. Not a pustule of rust could be found in the experimental block or in any of the fields near by. As regards the wetting properties of the various preparations, little change from what was noted under the first treatment was apparent. All of the liquids were slightly better in this respect, but this was no doubt due to the accumulation from the last spraying. Not a vestige of the first application of sulphur and sulphosteatite could be seen.

Third treatment (*December 5, 1891*).—At this time all the plats were examined, and in addition to collecting specimens from each, careful notes were made on the injuries, if any, resulting from the various treatments, the adhesiveness of the preparations, and the power each had of wetting the foliage. It was found that in plats 24 and 38, as well as their duplicates, not a grain had started. The first of these received a soil treatment of 13½ ounces of potassium bichromate solution to the plat; the second was a seed treatment, and consisted of immersing the grain twenty-four hours in a 1:1000 solution of corrosive sublimate.

Plats 26, 28, 32, 70, 72, and 82 were in very bad condition, not more than 1 per cent of the grain in any case having started. The methods of treating these plats has been given in Table 1. By referring to this it will be seen that in every case where hot water was used the grain either failed entirely to start or else made a very feeble growth. A good opportunity of testing the adhesiveness of the various preparations was offered in consequence of a rainfall of nearly an inch since the last spraying. Ferrous ferrocyanide, cupric ferrocyanide, copper borate, Bordeaux mixture, ammoniacal solution, and cupric hydroxide showed on the foliage in the order named. Ferric chloride and potassium sulphide solution were scarcely visible, and sulphur and sulphosteatite had entirely disappeared. The power of wetting the foliage was constant for each preparation throughout the entire experiment

Given in the order of their efficacy in this respect they are as follows: Ferrous ferrocyanide, copper borate, cupric ferrocyanide, ammoniacal solution, Bordeaux mixture, cupric hydroxide, ferric chloride, and potassium sulphide.

Fourth, fifth, and sixth treatments (December 14 and 23, 1891, and January 4, 1892).—Nothing of importance was noted in the intervals elapsing between these treatments. At the time of the fourth spraying the potassium sulphide and ferrous sulphate solutions were injuring the foliage so badly that it was decided to dilute them to one half the original strength. One peculiar fact noted in connection with the Bordeaux-sprayed plats was the entire absence of dew from such portions of the leaves as were covered by the preparation. It was thought that this might have an important bearing on the prevention of rust, as the presence of dew is known to be necessary for the infection of the host in the case of many parasitic fungi. Further observation, however, showed that this point was of no importance so far as our work was concerned. It was only possible to make about half of the sixth treatment, as snow began falling soon after spraying commenced and in an hour the plants were completely covered.

Seventh treatment (January 29, 1892).—From January 4 until this date the ground was covered with snow, making it impossible to reach the plants with a spray. Up to this time the most careful search had failed to reveal any trace of rust. The plants had made no growth since the spraying on January 4. With the exception of plats 44, 56, 58, and 60, treated respectively with potassium sulphide solution, ferric chloride solution, sulphur, and sulphosteatite, all the preparations were showing more or less plainly on the foliage. The ferrous ferrocyanide was especially prominent, while cupric ferrocyanide, Bordeaux mixture, and ammoniacal solution followed in this respect in the order named.

Eighth, ninth, tenth, and eleventh treatments (February 9 and 19, March 4 and 14, 1892, respectively).—At the time of each of the foregoing treatments specimens were collected from each plat and careful notes were made on them. However, nothing worthy of recording was observed.

Twelfth treatment (March 25, 1892).—The weather at this time was quite spring-like and many of the plants were beginning to grow. The duplicate plats were not in as good condition as the others, probably on account of being planted later and not having had an opportunity of getting well started before winter set in. Nothing of special importance was noted at this time.

Thirteenth, fourteenth, and fifteenth treatments (April 5, 16, and 26, 1892).—From March 25 to April 5 the plants made a growth of from 3 to 4 inches. Between the 5th and 16th the weather was quite cool, in consequence of which vegetation remained almost at a standstill. As regards the adhesiveness, wetting power, and injurious effects of

the various solutions, nothing different from what had been previously observed was noted. As yet not a sign of rust had been seen on any of the plants. It was noticed that the plants sprayed with ferrous ferrocyanide, Bordeaux mixture, and ammoniacal solution of copper carbonate were much greener than any of the others. This difference in color of foliage, due to the applications of chemicals in the form of spray, is, however, not peculiar to wheat. It has frequently been seen in the case of similar work upon other crops, but no attempts have been made to explain it.

Sixteenth treatment (May 6, 1892).—On May 1 rust was found on 1 of the untreated plats, a few pustules being seen on the leaves of several stalks arising from one root. It was decided to make no further examination until May 6, the day for the regular treatment. At this time, therefore, every plat was examined and the number of plants showing rust was counted. The rust was noted as being present if only one pustule occurred on a plant. The counting entailed an enormous amount of work, but it was the only way the desired knowledge could be obtained. The plants in all of the original plats averaged at this time from 15 to 18 inches in height, and in most respects were in good condition. Below is given, in tabular form, the results of the count on May 6.

TABLE 2.—*Showing number of plants affected with rust on May 6.*

SERIES I.—SOIL TREATMENT.

Plat.		Method of treating.	No. of plants showing rust.		Total plants showing rust.
Original.	Duplicate.		Original.	Duplicate.	
1	91	Untreated	27	0	27
2	92	Flowers of sulphur, 4 ounces to 20 feet of row	50	40	90
3	93	Untreated	25	0	25
4	94	Flowers of sulphur, 2 ounces to 20 feet of row	40	0	40
5	95	Untreated	0	0	0
6	96	Flowers of sulphur, 1 ounce to 20 feet of row	26	0	26
7	97	Untreated	29	16	45
8	98	Flowers of sulphur and lime, equal parts mixed, 4 ounces to 20 feet of row	21	0	21
9	99	Untreated	0	2	2
10	100	Flowers of sulphur and lime mixed, 2 ounces to 20 feet of row	4	0	4
11	101	Untreated	18	0	18
12	102	Ferrous sulphate, 4 ounces to 20 feet of row	15	0	15
13	103	Untreated	31	0	31
14	104	Ferrous sulphate, 8 ounces to 20 feet of row	12	0	12
15	105	Untreated	56	0	56
16	106	Bordeaux mixture, ½ gallon to 20 feet of row	37	0	37
17	107	Untreated	21	0	21
18	108	Potassium sulphide, ½ ounce to ½ gallon of water to 20 feet of row	31	0	31
19	109	Untreated	93	0	93
20	110	Ammoniacal solution, ½ gallon to 20 feet of row	61	0	61
21	111	Untreated	5	0	5
22	112	Bordeaux mixture, ½ gallon to 20 feet of row	7	0	7
23	113	Untreated	1	49	50
24	114	Potassium bichromate, 1½ ounces in 1½ quarts water per plat	dead	dead	....
25	115	Untreated	47	0	47

TABLE 2.—*Showing number of plants affected with rust on May 6*—Continued.

SERIES II.—SEED TREATED BY IMMERSION.

Plat. Original.	Plat. Duplicate.	Method of treating.	No. of plants showing rust. Original.	No. of plants showing rust. Duplicate.	Total plants showing rust.
26	116	Water heated to 132½° F., 15 minutes	6	0	6
27	117	Untreated	0	0	0
28	118	Copper sulphate, 24 hours in 8:100 solution	3	0	3
29	119	Untreated	1	0	1
30	120	Bordeaux mixture, 24 hours	21	0	21
31	121	Untreated	20	0	20
32	122	Potassium bichromate, 24 hours, 5:100 solution	0	0	0
33	123	Untreated	3	0	3
34	124	Potassium sulphide, 24 hours, solution containing 1 ounce of potassium sulphide to 1 gallon of water	55	0	55
35	125	Untreated	0	0	0
36	126	Potassium sulphide, 24 hours, solution containing ½ ounce to 1 gallon of water	7	0	7
37	127	Untreated	0	0	0
38	128	Corrosive sublimate, 1:1000 solution, 24 hours	0	0	0
39	129	Untreated	0	0	0

SERIES III.—PLANTS SPRAYED AND DUSTED.

40	130	Bordeaux mixture, every 10 days	0	0	0
41	131	Untreated	42	0	42
42	132	Ammoniacal solution, every 10 days	0	0	0
43	133	Untreated	58	0	58
44	134	Potassium sulphide solution, 1 ounce to 1½ gallons of water, every 10 days	1	0	1
45	135	Untreated	24	0	24
46	136	Bordeaux mixture, every 20 days	2	0	2
47	137	Untreated	0	0	0
48	138	Ammoniacal solution, every 20 days	10	0	10
49	139	Untreated	15	0	15
50	140	Cupric ferrocyanide mixture, every 10 days	8	0	8
51	141	Untreated	25	0	25
52	142	Ferrous ferrocyanide mixture, every 10 days	4	0	4
53	143	Untreated	3	0	3
54	144	Copper borate mixture, every 10 days	0	0	0
55	145	Untreated	37	0	37
56	146	Ferric chloride solution, every 10 days	0	0	0
57	147	Untreated	12	0	12
58	148	Flowers of sulphur, dusted on every 10 days	20	0	20
59	149	Untreated	1	0	1
60	150	Sulphosteatite, dusted on every 10 days	10	0	10

SERIES IV.—MISCELLANEOUS TREATMENTS.

61	151	Untreated	1	0	1
62	152	Seed immersed for 24 hours in Bordeaux mixture, ground sprayed before planting, and plants sprayed every 10 days with same preparation	0	0	0
63	153	Untreated	0	0	0
64	154	Seed immersed 24 hours in potassium sulphide solution, 1 ounce to 1 gallon of water, soil sprayed, and plants sprayed every 10 days with the same preparation	0	0	0 3
65	155	Untreated	3	0	
66	156	Seed immersed in hot water 15 minutes, ground sprayed with ammoniacal solution, and plants sprayed with same preparation every 10 days	0	0	0
67	157	Untreated	8	0	8
68	158	Seed immersed in hot water 15 minutes, soil sprayed with Bordeaux mixture, and plants sprayed with same preparation every 10 days	0	0	0
69	159	Untreated	65	6	71
70	160	Seed immersed in hot water 15 minutes, soil treated with lime and sulphur, equal parts, 4 ounces to 20 feet of row	0	0	0
71	161	Untreated	83	0	83

TABLE 2.—*Showing number of plants affected with rust on May 6*—Continued.

SERIES IV.—MISCELLANEOUS TREATMENTS—Continued.

Plat.		Method of treating.	No. of plants showing rust.		Total plants showing rust.
Original.	Duplicate.		Original.	Duplicate.	
72	162	Seed immersed 15 minutes in hot water, soil treated with ferrous sulphate, 2 ounces to 20 feet of row	0	0	0
73	163	Untreated	5	0	5
74	164	Seed treated 24 hours in 10:100 solution of ferrous sulphate, soil sprayed with same preparation, plants sprayed every 10 days with 4 ounces to 1 gallon of water	0	0	0
75	165	Untreated	10	0	10
76	166	Seed immersed 24 hours in ammoniacal solution, plants sprayed every 10 days with same preparation	0	0	0
77	167	Untreated	25	0	25
78	168	Soil treated with salt, $\frac{1}{10}$ ounce to 10 feet of row	8	0	8
79	169	Untreated	20	0	20
80	170	Soil treated with salt, $\frac{1}{20}$ ounce to 20 feet of row	35	0	35
81	171	Untreated	17	0	17
82	172	Soil treated with copper sulphate solution, 13½ ounces to 13½ quarts of water per plat	nearly dead.		....
83	173	Untreated	0	0	0
84	174	Plants sprayed with cupric hydroxide mixture every 10 days	0	0	0
85	175	Untreated	0	0	0

In a study of the foregoing table one of the most striking things noticed is the absence of rust from nearly all the duplicate plats. It should be remembered that all of these were planted from a week to ten days later than the originals; in point of growth they were at least this much behind the latter at the time of the count. The only suggested explanation of lack of rust at this time is upon the assumption that the plants had not reached the proper age for infection. If this be true, as subsequent observations would seem to indicate, the fact has considerable practical value, as it would point to the possible existence of what may be called a susceptible period, at which time a special effort in the way of protecting the plant would be highly important. If such a period really exist the earlier treatments would be of little use and consequently might be abandoned. Looking over the soil treatments, it appears that in no case did they have any appreciable effect on the prevalence of rust. The 12 plats treated gave 304 plants affected, while the untreated showed 354 plants.

In the case of the plats where seed treatments were made, 92 plants were found affected with rust, while the 7 untreated plats used as control gave only 24 plants. The plats sprayed and dusted showed some interesting results. No rust whatever was found on No. 40, sprayed every ten days with Bordeaux mixture, nor could the slightest trace of the fungus be discovered on plat 42, sprayed with ammoniacal solution every ten days. The untreated plats adjoining Nos. 40 and 42 showed, respectively, 42 and 58 affected plants. The plats sprayed with Bordeaux mixture and ammoniacal solution every twenty days were not in as good condition as those where the ten-day treatments were employed. Taking the sprayed and dusted plats as a whole, there was no striking

difference between them and the untreated so far as rust was concerned. Where Bordeaux mixture, ammoniacal solution, ferrous ferrocyanide, and cupric ferrocyanide were used the wheat was certainly much greener and more vigorous than in the untreated plats. In the miscellaneous treatments nothing appears to warrant the assumption that any of them prevented rust.

In searching for the rust an interesting fact was brought out in connection with the distribution and spread of the fungus. In every case the affected plants were found in spots scattered here and there in the plat. Frequently 25 or 30 plants growing together would be found badly rusted, while plants all around would be perfectly free from the disease. Again a single plant in a plat would be found showing perhaps only one affected leaf. Observations made upon these rust areas revealed the fact that they acted as centers of infection, the parasite spreading from them to adjoining plants and thence to other parts of the field.

Examining the weather record for ten days preceding the discovery of rust, we find nothing to warrant the belief that the simultaneous appearance of the fungus the first week in May in widely separated spots was due to peculiar climatic conditions. The weather conditions at this time, so far as relates to temperature and rainfall, were not abnormal, as will be seen by consulting the table given below:

TABLE 3.—*Showing the daily mean temperature and daily precipitation at Garrett Park, Md., from April 20, 1892, to May 20, 1892.*

Date.	Temperature.	Precipitation.
Apr. 20	40	0.85
Apr. 21	44	1.30
Apr. 22	52	0.80
Apr. 23	54	Trace.
Apr. 24	55	....
Apr. 25	46	....
Apr. 26	49	....
Apr. 27	53	....
Apr. 28	62	....
Apr. 29	62	0.46
Apr. 30	58	....
May 1	62	....
May 2	62	Trace.
May 3	66	....
May 4	66	....
May 5	75	....
May 6	65	....
May 7	62	....
May 8	45	....
May 9	61	Trace.
May 10	50	....
May 11	64	0.69
May 12	56	....
May 13	57	....
May 14	56	0.69
May 15	56	Trace.
May 16	59	....
May 17	65	....
May 18	56	1.10
May 19	59	....
May 20	62	....

Seventeenth treatment (*May 16, 1892*).—No critical notes were made on the experiment at this time. All plats were sprayed and dusted in the usual way, and from 50 to 100 specimens were collected from each.

It was seen that the rust was spreading rapidly on all the plats except those treated every ten days with Bordeaux mixture, ammoniacal solution, ferrous ferrocyanide, cupric ferrocyanide, and copper borate. As far as could be determined from a superficial examination, the plats sprayed with the two first-named preparations and with ferrous ferrocyanide were wholly free from rust.

Another fungus appeared at this time, and for a while threatened to occasion as much damage as rust. Microscopic examination revealed the fact that this parasite was *Septoria graminum* Desm., a fungus known to occur on many grasses in various parts of the world. The leaves attacked by the *Septoria* show at first brownish elongated spots; these soon run together and eventually the leaf turns yellowish brown and shrivels up. In addition to the foregoing disease it was found that many lower leaves on every plant were turning yellow without the attacks of fungi or parasites of any kind. For a time the yellowing was thought to be a normal appearance due to old age, and to a certain extent this was probably the case. From the fact, however, that the yellowing was largely absent on the parts sprayed with Bordeaux mixture, ammoniacal solution, and ferrous ferrocyanide, it would appear that these treatments, either indirectly by their action on the soil, or directly by exerting some influence on the host, had enabled the first-formed leaves to perform their functions beyond the usual period. The explanation of the phenomenon, however, involves the discussion of physiological questions beyond the province of this paper. The only object in mentioning the matter at this point is to make clear the subsequent notes on the effects of the treatments. In view of the near approach of harvest it was decided to make no further treatments, but the observations were continued at intervals of four to eight days. These will be given under headings the same as in treatments.

Observations on May 24, 25, and 26, 1892.—Preparations were made on May 23 for a critical examination of every plat. A schedule of points to be noted was prepared and this was followed as nearly as possible throughout the examination. The schedule was as follows:

(1) *General condition.*—Under this heading three things were considered, namely, (*a*) size of plants, (*b*) color of plants, and (*c*) number of plants to the plat. On a scale of 100, size was made to count 50 points, color 30 points, and number of plants to the plat 20 points. The standard for size and number of plants to the plat was obtained from plants in an adjoining field. In considering color, the entire absence of yellow leaves, whether due to fungi or other causes, was taken as perfect, in this case giving 30 points.

(2) *Detailed condition.*—In this case six things were considered, namely: (*a*) Size of plants, (*b*) amount of rust, (*c*) amount of *Septoria graminum*, (*d*) amount of other fungi, (*e*) amount of yellow foliage, and (*f*) injury from the treatments. To obtain the size of the plants, measurements were made at three points in each plat and the average taken. It was planned to determine the amount of rust by an actual

count of the affected plants, but this was found to be out of the question, as it would have involved the counting of almost every stalk. When it was found that the rust was so widely distributed, a count of only a few of the more promising looking plats was made. The data on the amount of *Septoria*, yellow foliage, etc., was obtained by carefully examining the plats and marking the results in percentages. It is hardly necessary to give in detail the figures obtained as a result of the foregoing observations. Summarizing the data, it may be stated as follows:

(1) The general condition of all the original plats, with the exception of those treated with Bordeaux mixture, ammoniacal solution of copper carbonate, ferrous ferrocyanide, and copper borate, was the same, averaging 55 to 75 when compared with wheat in the field taken as 100. The poor condition of the wheat, treated as well as untreated, when compared with the ordinary field crop, was due to a number of causes, the most important being the omission of fertilizers in planting and the thinness of the plants due to necessary walks, alleys, etc. The condition of the plats sprayed with Bordeaux mixture, ammoniacal solution of copper carbonate, ferrous ferrocyanide, cupric ferrocyanide, and copper borate averaged 90 to 100, when compared with the field crop.

(2) The general condition of all the duplicate plats was 10 to 20 points lower than the original.

(3) There was no marked difference in the height of the plants in the various plats, the average for the originals being 18 to 30 inches and the duplicates 14 to 24 inches.

(4) The amount of rust on the various plats, as nearly as could be determined, was the same, fully 90 per cent of the plants in every case being affected. An actual count of the rusted plants in 13 plats gave the following results:

TABLE 4.—*Showing actual number of rusted plants on 14 plats.*

Plat.	Method of treating.	Number of plants showing rust.
1	Untreated	1,908
2	Soil treatment with sulphur	2,500
3	Untreated	1,910
4	Soil treatment with sulphur	2,368
5	Untreated	2,196
6	Soil treatment with sulphur	1,741
40	Sprayed with Bordeaux mixture every 10 days	2,716
41	Untreated	2,568
42	Sprayed with ammoniacal solution every 10 days	1,247
44	Sprayed with potassium sulphide solution every 10 days	2,729
46	Sprayed with Bordeaux mixture every 20 days	2,456
48	Sprayed with ammoniacal solution every 20 days	2,672
50	Sprayed with cupric ferrocyanide mixture every 10 days	2,736
52	Sprayed with ferrous ferrocyanide mixture every 10 days	2,548

Each of the foregoing plats contained from 2,600 to 3,400 plants.

(5) *Septoria graminum* occurred upon all the plats, from 5 to 10 per cent of the foliage being affected. It was worse where the plants were thick, and was almost entirely absent where, from the effects of the seed treatments and other causes, the plants were thin. Spraying with

Bordeaux mixture and ammoniacal solution of copper carbonate prevented this fungus to a large extent.

(6) All plants except those sprayed with Bordeaux mixture, ammoniacal solution, and ferrous ferrocyanide, showed from 5 to 20 per cent of yellow foliage. The above exceptions were practically free from the trouble.

(7) The injury to the plants resulting from the work was only marked in the case of the soil and seed treatments. These are referred to in detail in Table 2.

Observations on June 4, 1892.—From May 26 to June 4 rust rapidly increased; in fact, at the latter date not a leaf could be found that did not show the fungus. The lower leaves were in every case the more badly diseased; the rust sori, however, were found in great quantities on the very topmost leaves. All the fields in the neighborhood were badly rusted, in many cases the plants being literally red with the fungus. For the first time the teleutospores were found and upon examination it was seen that they possessed all the characteristics of those belonging to *Puccinia rubigo-vera.* No further field notes were made and on June 9 the crop was harvested. The crop on each plat was cut in the usual manner, after which each bundle was marked with a numbered tag, and shocked after the ordinary fashion. The weight of the straw and grain, weight of grain, and weight of straw were next determined. The straw and grain together were first weighed, then the latter was flailed out and weighed, thus giving the rest of the data. A careful study of these figures reveals so little of interest that it is deemed unnecessary to publish them in full. The yield was fairly even throughout the field, the only striking differences in this respect being where the plants were thin on account of certain seed and soil treatments, the injurious effects of which have already been pointed out. Summing up this phase of the subject, it may be said that so far as affecting the yield, except in the cases noted, the treatments had no appreciable effect.

SUPPLEMENTARY EXPERIMENTS IN THE TREATMENT OF RUST OF WHEAT AND OTHER CEREALS AT GARRETT PARK, MARYLAND.

As a supplementary experiment it was decided early in March, 1892, to spray spring planted wheat, oats, and rye with a number of the standard fungicides, using full and half strength solutions. It was thought best to plant the grain as late as possible in order to invite the attacks of rust fungi. No harvest of course was expected. On May 17 fifty-seven plats, each 3 by 33 feet, were staked off. Thirty-six plats were planted with wheat, 12 with oats, and 9 with rye. In the case of each crop half of the plats were treated and half were left for control. The fungicides used were Bordeaux mixture, full and half strength, ammoniacal solution, full and half strength, sulphur and sulphosteatite. The Bordeaux mixture, full strength, contained 6 pounds of copper sulphate and 4 pounds of lime to 22 gallons of water. The ammoniacal solution was made by dissolving 2½ ounces

of copper carbonate in $1\frac{1}{2}$ pints of ammonia then diluting to 25 gallons. The sulphur and sulphosteatite were used as described in the experiment with winter wheat, p. 202. The plants were treated at intervals of two, ten, and twenty days, respectively, from the time they appeared above ground until they were 8 inches high. Without going into the details of the work the results may be briefly summarized as follows:

(1) Rust appeared more or less on all the plats when the plants were from 2 to 5 inches high.

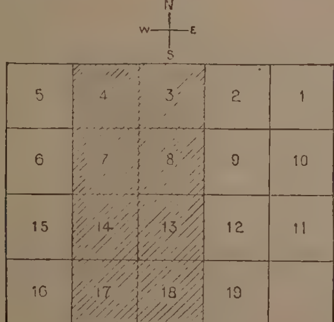
(2) The fungus was more abundant at first on the untreated plats and those dusted with flowers of sulphur and sulphosteatite. Despite the treatment, however, rust increased on every plat, and by the time the plants were 8 inches high there was no difference between the plats as regards the amount of the fungus.

In all cases where the liquids were used, soap was added to make them wet the leaves more thoroughly. It was found, however, exceedingly difficult to cover the foliage even when the sprayings were made every two days. In case of the oft-repeated treatments fully four fifths of the leaf surface was frequently found wholly unprotected.

EXPERIMENTS AT MANHATTAN, KANS.

Mr. J. F. Swingle, to whom the work at this place was entrusted, conducted the experiments on his farm a mile and a half from the State Agricultural College. Early in September, 1891, Mr. Swingle was requested to select from an average field of wheat a block containing 8,000 to 10,000 square feet. This was done, and on October 13 the ground was platted. Nineteen plats were laid out, each 20 feet square, in 4 rows, extending east and west. The plat in the southeast corner was cut out in order to give the necessary number. The accompanying diagram shows the arrangement of the plats, and the explanation gives the treatment each received:

DIAGRAM 4.—*Showing plan of experiment at Manhattan, Kans.*



EXPLANATION OF DIAGRAM 1.

Plats 1, 3, 5, 7, 9, 11, 13, 15, 17, and 19, untreated.

Plats 2, 8, and 14, sprayed every ten days with Bordeaux mixture, full strength, from the time the plants appeared above ground until harvest.

Plats 4, 10, and 16, sprayed every ten days with ammoniacal solution of copper carbonate, full strength, from the time the plants appeared above ground until harvest.

Plats 6, 12, and 18, sprayed every ten days with potassium sulphide solution, 2 ounces of potassium sulphide to 3 gallons of water, from the time the plants appeared above ground until harvest.

The land was rich bottom, having grown but one previous crop and that in 1891. By an accident a part of the field selected was plowed early in July. This part fortunately almost exactly coincided with plats 3, 4, 7, 8, 13, 14, 17, and 18. Mr. Swingle in commenting upon this point says:

In selecting the field of wheat I did not think of the early plowing a part of it received. This, as will be seen further on, had an important bearing on the yield of straw and grain. It so happened, however, that the lines running north and south and separating the early from the late plowing almost coincided with the lines separating certain plats. In considering the effect of the treatment, therefore, the plats plowed early should be compared with each other and not with those plowed late.

The sprayings were made with a knapsack pump and Vermorel nozzle, beginning on October 17 and ending June 13, no soap being used. On June 21, Mr. Swingle, acting under instructions from the writer, carefully examined the plats and estimated to the best of his ability the amount of rust on each. The figures obtained are set forth in the following table:

TABLE 5.—*Showing the per cent of rust on the treated and untreated plats June 21.*

Plat.	Kind of treatment.	Per cent of plants rusted.
1	Untreated	80
2	Bordeaux mixture	20
3	Untreated	90
4	Ammoniacal solution	95
5	Untreated	70
6	Potassium sulphide	75
7	Untreated	90
8	Bordeaux mixture	10
9	Untreated	70
10	Ammoniacal solution	75
11	Untreated	90
12	Potassium sulphide	40
13	Untreated	100
14	Bordeaux mixture	25
15	Untreated	75
16	Ammoniacal solution	75
17	Untreated	100
18	Potassium sulphide	75
19	Untreated	90

According to the foregoing estimate, the plats sprayed with Bordeaux mixture were much more free from rust than any of the others and potassium sulphide was better than ammoniacal solution. The early plowing did not seem to affect the results at all, so far as rust was concerned. Mr. Swingle was directed to collect material from all the plats and forward it to Washington for examination. This was done, and the

results of a critical study of the material showed that the estimate made in the field, regarding the amount of rust on each plat, was a conservative one. On June 27 and 28 the grain was harvested with a sickle, each plat being trimmed down beforehand to 16½ feet square. Nothing further was done with the grain until August 8, when the straw and grain were weighed and the latter threshed out with a flail.

The result of this work is set forth in the following table:

TABLE 6.—*Showing weight of straw and grain and weight of grain and of straw from each plat.*

Plat.	Kind of treatment.	Weight of straw and grain.	Weight of grain.	Weight of straw.
1	Untreated, late plowing	23	7	15
5	......do	23	7	15
2	Bordeaux mixture, late plowing	24	7	16
3	Untreated, early plowing	34	10	24
8	Bordeaux mixture, early plowing	34	11	23
14	......do	32	10	22
7	Untreated, early plowing	31	9	21
10	Ammoniacal sol tion, late plowing	28	9	19
11	Untreated, late plowing	17	5	8
4	Ammoniacal solution, early plowing	35	9	25
13	Untreated, early plowing	29	8	20
16	Ammoniacal solution, late plowing	24	8	15
19	Untreated, late plowing	15	5	9
12	Potassium sulphide, late plowing	19	6	13
9	Untreated, late plowing	20	7	13
18	Potassium sulphide, early plowing	33	10	23
15	Untreated, late plowing	20	6	13
6	Potassium sulphide, late plowing	25	7	17
17	Untreated, early plowing	32	9	23

The plats are arranged so as to bring those plowed early and late together, for the sake of more conveniently comparing them. A study of the figures reveals the fact that there are no very striking differences in favor of any of the treatments. Comparing the total yield of plats 8 and 14, sprayed with Bordeaux mixture, plowed early, with the the yield of plats 3 and 13, the nearest untreated plats, plowed early, it is seen that there is an increase of 3 pounds in the total yield and 3 pounds in the yield of grain in favor of the spraying. Plat 2, treated with Bordeaux mixture and plowed late, yielded only 1 pound more straw than plat 1, untreated. Compared with untreated plat 9, however, plat 2 yielded 3 pounds more straw for the same amount of grain. Where the plats were sprayed with the ammoniacal solution, there was an increase in every case of the treated over the untreated; in fact, the difference, between the sprayed and unsprayed plats was here more striking than where Bordeaux mixture was used. It is doubtful, however, if this increase was due to the prevention of rust, for, as shown in Table 5, these plats were almost as badly rusted as the untreated. It is barely possible that the increased yield was due to the fertilizing effect of the ammoniacal solution on the soil. The plats sprayed with potassium sulphide gave about the same amount of increase as those treated with the ammoniacal solution. There is no apparent reason for believing that the increase was due to the prevention of rust. On the other hand, there is some proof that increased fertility of the soil, due to the application of the potassium sulphide,

might have caused the difference noted. Summing up the results of this experiment, it may be said that so far as could be ascertained by a careful examination Bordeaux mixture did, to a considerable extent, prevent rust, but the other preparations had little or no effect on the disease. Furthermore in no case did the prevention of rust affect the yield to any appreciable extent.

EXPERIMENTS AT ROCKPORT, KANS.

Mr. Bartholomew's farm, where the experiments described in the following pages were conducted, is located in Rooks County, latitude 39° 30′ north and longitude 99° 20′ west. Three lines of work were carried on at his place, which may be designated as experiments A, B, and C, respectively.

EXPERIMENT A.

This experiment was, to a certain extent, the same as that conducted with winter wheat at Garrett Park, Md., there being ten kinds of soil treatment, seven of seed treatment, six treatments involving spraying, and six combining all three of the foregoing. The soil selected for the work was rich second bottom, so situated as to render the crops planted upon it peculiarly subject to the attacks of rust fungi. In accordance with instructions from the Department, Mr. Bartholomew early in October, 1891, staked off 132 plats, each 25 feet long and 4½ feet wide. From October 9 to 15 the wheat was planted, the variety known as "Turkey" being used. The grain was all planted in rows 9 inches apart, there being five rows in each plat. Eighteen inches were left between plats to serve as walks. The following is a tabular statement showing the treatment each plat received:

TABLE 7.—*Showing manner of treatment of plats in Experiment A, at Rockport, Kans.*

Plat.	Kind of treatment.
1 and 66	Untreated.
2 and 67	Soil treatment with flowers of sulphur, 5 ounces to 25 feet of row.
3 and 68	Untreated.
4 and 69	Soil treatment with flowers of sulphur, 2½ ounces to 25 feet of row.
5 and 70	Untreated.
6 and 71	Soil treatment with flowers of sulphur, 1¼ ounces to 25 feet of row.
7 and 72	Untreated.
8 and 73	Soil treatment with lime and sulphur, equal parts mixed, 5 ounces to 25 feet of row.
9 and 74	Untreated.
10 and 75	Soil treatment with lime and sulphur, equal parts mixed, 2½ ounces to 25 feet of row.
11 and 76	Untreated.
12 and 77	Soil treatment with powdered exsiccated ferrous sulphate, 5 ounces to 25 feet of row.
13 and 78	Untreated.
14 and 79	Soil treatment with 5 pints of water containing 5 ounces exsiccated ferrous sulphate to 25 feet of row.
15 and 80	Untreated.
16 and 81	Soil treatment with Bordeaux mixture, 5 pints to 25 feet of row.
17 and 82	Untreated.
18 and 83	Soil treatment with 5 pints of water containing 1¼ ounces potassium sulphide to 25 feet of row.
19 and 84	Untreated.
20 and 85	Soil treatment with 5 pints of ammoniacal solution of copper carbonate to 25 feet of row.
21 and 86	Untreated.
22 and 87	Seed immersed in water at 133° F. for 15 minutes.
23 and 88	Untreated.
24 and 89	Seed immersed in an 8:100 solution of copper sulphate for 24 hours, then limed.
25 and 90	Untreated.
26 and 91	Seed immersed for 24 hours in Bordeaux mixture.
27 and 92	Untreated.
28 and 93	Seed immersed for 24 hours in a 5:100 solution of potassium bichromate.
29 and 94	Untreated.

TABLE 7.—*Showing manner of treatment of plats in Experiment A, at Rockport, Kans.*—Continued.

Plat.	Kind of treatment.
30 and 95	Seed immersed for 24 hours in a solution of potassium sulphide, 1 ounce to 1 gallon of water.
31 and 96	Untreated.
32 and 97	Seed immersed for 24 hours in a solution of potassium sulphide, ½ ounce to 1 gallon of water.
32½ and 98	Untreated.
33 and 99	Untreated.
34 and 100	Seed immersed for 24 hours in a 1:1000 solution of corrosive sublimate.
35 and 101	Untreated.
36 and 102	Plants sprayed every 10 days with Bordeaux mixture.
37 and 103	Untreated.
38 and 104	Plants sprayed every 10 days with ammoniacal solution of copper carbonate.
39 and 105	Untreated.
40 and 106	Plants sprayed every 10 days with potassium sulphide solution, 2 ounces to 3 gallons of water.
41 and 107	Untreated.
42 and 108	Plants sprayed with Bordeaux mixture every 20 days.
43 and 109	Untreated.
44 and 110	Plants sprayed with ammoniacal solution of copper carbonate every 20 days.
45 and 111	Untreated.
46 and 112	Plants sprayed with potassium sulphide solution, 2 ounces to 3 gallons of water every 20 days.
47 and 113	Untreated.
48 and 114	Seed, soil, and spraying treatments. Seed immersed in Bordeaux mixture 24 hours; soil treated with 5 pints of Bordeaux mixture to 25 feet of row; plants sprayed with Bordeaux mixture every 10 days.
49 and 115	Untreated.
50 and 116	Seed, soil, and spraying treatments, with potassium sulphide solution, 2 ounces to 3 gallons of water. Seed immersed for 24 hours; soil treated with 5 pints to 25 feet of row; plants sprayed every 10 days.
51 and 117	Untreated.
52 and 118	Seed, soil, and spraying treatments. Seed immersed for 24 hours in ammoniacal solution of copper carbonate, plants sprayed every 10 days with the same preparation.
53 and 119	Untreated.
54 and 120	Seed and spraying treatments. Seed immersed for 15 minutes in water at 133° F.; plants sprayed every 10 days with Bordeaux mixture.
55 and 121	Untreated.
56 and 122	Seed and soil treatment. Seed immersed for 15 minutes in water at 133° F.; soil treated with lime and sulphur equal parts, 5 ounces to 25 feet of row.
57 and 123	Untreated.
58 and 124	Seed and soil treatment. Seed immersed in water at 133° F. for 15 minutes; soil treated with 2½ ounces ferrous-sulphate to 25 feet of row.
59 and 125	Reserved for spring treatment.
60 and 126	
61 and 127	
62 and 128	
63 and 129	
64 and 130	
65 and 131	

The Bordeaux mixture and ammoniacal solution used throughout the foregoing experiment were full strength, *i. e.*, containing, respectively, 6 pounds of copper and 4 pounds of lime to 22 gallons of water, and 3 ounces of copper basic carbonate dissolved in 1½ pints of ammonia to 22 gallons of water. Soap was not used with any of the preparations. All of the soil and seed treatments were made before the grain was planted. Spraying began on October 28, and with the exception of three interruptions caused by cold weather and snow, was continued at the regular ten and twenty-day intervals until harvest. No rust appeared until May 24, but from this time on it increased very rapidly, every plat in the entire tract being attacked to a greater or less extent. Upon examination the fungus proved to be *Puccinia rubigo-vera*, the common species of western Kansas. In accordance with directions from the Department, Mr. Bartholomew made careful notes on the

various plats with respect to the effects of the treatments on rusts and other fungi. After harvesting, the total yield of straw and grain, the yield of straw, and the yield of grain were each ascertained. From this data the following notes on the general effect of the treatment on each plat were prepared by Mr. Bartholomew:

Plats 1 and 66.—Untreated. These were so near like all other untreated plats that their condition may be taken as a standard. Three fungi were noted upon the plants, viz, *Puccinia rubigo-vera* on nearly every leaf, *Puccinia graminis* on an occasional stalk, and *Septoria graminum* on many of the leaves, but causing no serious damage.

Plats 2 and 67, 4 and 69, 6 and 71.—Soil treatment with flowers of sulphur; yield of both straw and wheat above the average, but the red rust was noticeable on every plant, not, however, in destructive quantities, as the wheat was full and plump.

Plats 8 and 73, 10 and 75.—Soil treatment with sulphur and lime; showed the usual amount of rust, with an average product of wheat and straw.

Plats 12 and 77.—Soil treatment with sulphate of iron; showed the rust in average quantities and yielded a medium amount of grain.

Plats 14 and 79.—Soil treatment with ferrous sulphate in water; did not show as good results in yield as 12 and 77. The usual amount of rust was present.

Plats 16 and 81.—Soil treatment with Bordeaux mixture; showed normal amount of rust, and the yield fell considerably below the average.

Plats 18 and 83.—Soil treatment with sulphide of potassium solution; showed the usual mount of rust and yielded below the average.

Plats 20 and 85.—Soil treatment with ammoniacal solution of copper carbonate; seemed to produce a bad effect on the germination of the seed, as the stand was thin, badly rusted, and the yield much below the average.

Plats 22 and 87.—Hot-water treatment of seed; showed normal amount of rust and decreased yield.

Plats 24 and 89.—Seed treated by immersing for twenty-four hours in 8:100 solution of copper sulphate, then limed; showed usual amount of rust and a yield lower than the adjoining untreated plats.

Plats 26 and 91.—Seed treated by immersing for twenty-four hours in Bordeaux mixture; gave fairly good average results, but was rusted.

Plats 28 and 93.—Seed treated by immersing for twenty-four hours in a 5:100 solution of potassium bichromate; badly rusted and yield lower than the average.

Plats 30 and 95.—Seed treated by immersing for twenty-four hours in potassium sulphide solution; produced fair results, though rusted as usual.

Plats 32 and 97.—Treated the same as the preceding, but with solution only half as strong; yielded a very inferior crop, which was badly rusted.

Plats 34 and 100.—Seeds treated by immersing for twenty-four hours in 1:1000 solution of corrosive sublimate; injured the vitality of the seed and gave a very light yield, with usual amount of rust.

Plats 36 and 102.—Sprayed with Bordeaux mixture every ten days from October 28 until June 24; yielded above the average and were not nearly so badly rusted as the preceding numbers or as the adjoining untreated plats.

Plats 38 and 104.—Sprayed every ten days with ammoniacal solution of copper carbonate; also yielded in excess of the average and were very slightly rusted.

Plats 40 and 106.—Sprayed every ten days with sulphide of potassium solution, 2 ounces to 3 gallons of water; did not show as good results, yet produced better yields than the adjoining untreated plats, being more free from rust but not so free as the two preceding groups.

Plats 42 and 108.—Sprayed every twenty days with Bordeaux mixture; yielded results very similar to plats 36 and 102, but showed more rust.

Plats 44 and 110.—Sprayed every twenty days with ammoniacal solution; was not so successful as plats 38 and 104, treated every ten days with the same preparation.

Plats 46 and 112.—Sprayed every twenty days with potassium sulphide solution; gave little or no effect in preventing rust, but yielded better than the adjoining untreated plats.

Plats 48 and 114.—Seed, soil, and spraying treatments with Bordeaux mixture; seed immersed twenty-four hours, soil treated with one-half gallon to 20 feet of row, and plants sprayed every ten days. This treatment was well nigh fatal, giving the lightest yield of any group in the whole tract; very little rust.

Plats 50 and 116.—The treatment of these plats was exactly the same as the preceding, only potassium sulphide was used instead of Bordeaux mixture. The results were very unsatisfactory and the yield light; very little rust.

Plats 52 and 118.—Seed, soil, and spraying treatments with ammoniacal solution of copper carbonate; plants sprayed every ten days and soil treated with 2 gallons of the solution to 20 feet of row; not much rusted; yield normal.

Plats 54 and 120.—Seed and spraying treatment, the latter every ten days with Bordeaux mixture, the former with hot water; slightly rusted; very similar to the preceding group.

Plats 56 and 122.—Seed and soil treatment; hot-water treatment for seed; 2 ounces flowers of sulphur and 2 ounces air-slaked lime mixed to 20 feet of row for soil. The yield was about up to the average, but no appreciable lessening of the rust could be detected.

Plats 58 and 124.—Seed and soil treatment; hot-water treatment for seed; 2½ ounces ferrous sulphate to 25 feet of row for soil; normal yield, but no diminution of rust.

The following plats, as already indicated, were held for spring treatment:

Plats 60 and 126.—Sprayed with Bordeaux mixture; the yield was good and the rust was considerably less than on the adjoining untreated plats.

Plats 62 and 128.—Sprayed on the same dates as the last 2 plats, with ammoniacal carbonate of copper solution; very similar to the preceding group in all respects.

Plats 64 and 130.—Sprayed at the same time as 62 and 128, with potassium sulphide solution, 2 ounces to 3 gallons of water; this spraying was deleterious and decreased the yield noticeably; it had little effect in preventing rust.

In the following table is shown the yield of straw and grain for each plat and its duplicate:

TABLE 8.—*Showing kind of treatment and yield of grain and straw.*

Plat.	Kind of treatment.	Yield of grain and straw.		Yield of cleaned grain.	
		Lbs.	*Oz.*	*Lbs.*	*Oz.*
1 and 66	Untreated	11	2	2	2
	......do	9	9	1	10
2 and 67	Soil treatment with flowers of sulphur, 5 ounces to 25 feet of row	12	12	3	2
		11	4	2	12
3 and 68	Untreated	9	12	1	12
	......do	9	6	1	12
4 and 69	Soil treatment with flowers of sulphur, 2½ ounces to 25 feet of row	11	14	2	6
		11	4	2	4
5 and 70	Untreated	10	13	2	0
	......do	10	13	1	14
6 and 71	Soil treatment with flowers of sulphur, 1¼ ounces to 25 feet of row	12	0	2	8
		11	8	2	4
7 and 72	Untreated	10	4	2	2
	......do	10	0	2	0
8 and 73	Soil treatment with lime and sulphur, equal parts mixed, 5 ounces to 25 feet of row	10	10	2	6
		10	5	2	2
9 and 74	Untreated	9	0	1	10
	......do	9	9	2	0
10 and 75	Soil treatment with lime and sulphur, equal parts mixed, 2½ ounces to 25 feet of row	13	5	2	8
		11	4	2	2
11 and 76	Untreated	9	14	1	12
	......do	10	10	1	12
12 and 77	Soil treatment with powdered ferrous sulphate, 5 ounces to 25 feet of row	10	0	1	10
		11	6	2	2

TABLE 8.—*Showing kind of treatment and yield of grain and straw*—Continued.

Plat.	Kind of treatment.	Yield of grain and straw.		Yield of cleaned grain.	
		Lbs.	*Oz.*	*Lbs.*	*Oz.*
13 and 78	Untreated	12	4	2	4
	......do	11	6	2	0
14 and 79	Soil treatment with 5 pints of water containing 5 ounces	9	2	1	8
	of ferrous sulphate to 25 feet of row	9	14	1	12
15 and 80	Untreated	10	4	1	14
	......do	9	10	1	10
16 and 81	Soil treatment with 5 pints of Bordeaux mixture to 25	9	6	1	15
	feet of row	9	4	1	15
17 and 82	Untreated	10	6	2	0
	......do	9	8	1	12
18 and 83	Soil treatment with 5 pints of water containing $1\frac{1}{4}$ ounces	9	8	1	10
	of potassium sulphide to 25 feet of row	10	8	1	12
19 and 84	Untreated	10	10	1	14
	......do	8	12	1	8
20 and 85	Soil treatment with 5 pints of ammoniacal solution of	7	10	1	6
	copper carbonate to 25 feet of row	9	8	1	12
21 and 86	Untreated	10	8	1	14
	......do	10	4	1	15
22 and 87	Seed immersed in water at 133° F. for 15 minutes	7	8	1	9
		10	12	2	0
23 and 88	Untreated	10	12	2	2
	......do	10	6	2	0
24 and 89	Seed immersed in an 8:100 solution of copper sulphate	7	10	1	6
	for 24 hours, then limed	10	0	1	14
25 and 90	Untreated	11	0	2	6
	......do	10	12	2	5
26 and 91	Seed immersed for 24 hours in Bordeaux mixture	11	0	2	6
		11	0	2	4
27 and 92	Untreated	10	0	2	0
	......do	10	4	2	3
28 and 93	Seed immersed for 24 hours in a 5:100 solution of po-	9	0	2	0
	tassium bichromate	9	8	2	2
29 and 94	Untreated	10	10	2	5
	......do	10	0	2	0
30 and 95	Seed immersed for 24 hours in a solution of potassium	10	2	2	2
	sulphide, 1 ounce to 1 gallon of water	10	4	2	6
31 and 96	Untreated	11	8	2	6
	......do	11	0	2	0
32 and 97	Seed immersed for 24 hours in a solution of potassium	8	4	1	10
	sulphide, $\frac{1}{2}$ ounce to 1 gallon of water	8	0	1	12
$32\frac{1}{2}$ and 98	Untreated	11	6	2	2
	......do	11	4	2	4
33 and 99	......do	10	3	2	2
	......do	9	12	1	13
34 and 100	Seed immersed for 24 hours in a 1:1000 solution of cor-	9	10	1	14
	rosive sublimate	5	9	1	2
35 and 101	Untreated	10	9	2	4
	......do	10	6	2	4
36 and 102	Plants sprayed every 10 days with Bordeaux mixture	11	13	2	12
		11	6	2	3
37 and 103	Untreated	11	2	2	0
	......do	9	12	1	12
38 and 104	Plants sprayed every 10 days with ammoniacal solution	12	2	2	8
	of copper carbonate	10	12	2	6
39 and 105	Untreated	9	12	1	10
	......do	10	8	2	2
40 and 106	Plants sprayed every 10 days with potassium sulphide	10	10	2	1
	solution, 2 ounces to 3 gallons of water	10	12	2	6
41 and 107	Untreated	9	12	1	11
	......do	10	4	1	12
42 and 108	Plants sprayed every 20 days with Bordeaux mixture	12	4	2	8
		10	10	2	4
43 and 109	Untreated	9	10	1	11
	......do	11	4	2	5
44 and 110	Plants sprayed with ammonical solution of copper car-	10	8	1	12
	bonate every 20 days	9	14	1	12
45 and 111	Untreated	9	6	1	14
	......do	9	6	1	10
46 and 112	Plants sprayed with potassium sulphide solution, 2	10	4	1	12
	ounces to 3 gallons of water every 20 days	9	6	1	9
47 and 113	Untreated	8	2	1	5
	......do	8	12	1	7
48 and 114	Seed, soil, and spraying treatments; seed immersed in Bordeaux mixture 24 hours; soil treated with 5 pints	6	2	1	4
	of Bordeaux mixture to 25 feet of row; plants sprayed with Bordeaux mixture every 10 days	5	2	1	0
49 and 115	Untreated	10	8	2	0
	......do	9	12	1	14

TABLE 8.—*Showing kind of treatment and yield of grain and straw*—Continued.

Plat.	Kind of treatment.	Yield of grain and straw.		Yield of cleaned grain.	
		Lbs.	*Oz.*	*Lbs.*	*Oz.*
50 and 116	Seed, soil, and spraying treatments with potassium sulphide solution 2 ounces to 3 gallons of water; seed immersed for 24 hours; soil treated with 5 pints to 25 feet of row; plants sprayed every 10 days	7	12	1	6
		6	7	1	2
51 and 117	Untreated	10	0	1	12
	......do	10	4	1	10
52 and 118	Seed, soil, and spraying treatments; seed immersed for 24 hours in ammoniacal solution of copper carbonate; plants sprayed every 10 days with the same preparation	9	14	2	0
		10	12	2	5
53 and 119	Untreated	10	6	2	0
	......do	9	0	1	11
54 and 120	Seed and spraying treatments; seed immersed for 15 minutes in water at 133° F.; plants sprayed every 10 days with Bordeaux mixture	10	4	2	4
		9	2	1	9
55 and 121	Untreated	10	2	1	14
	......do	10	4	2	5
56 and 122	Seed and soil treatment; seed immersed for 15 minutes in water at 133° F.; soil treated with lime and sulphur, equal parts, 5 ounces to 25 feet of row	10	6	1	8
		11	12	1	14
57 and 123	Untreated	11	0	2	3
	......do	10	10	2	4
58 and 124	Seed and soil treatments; seed immersed in water at 133° F. for 15 minutes; soil treated with 2½ ounces of ferrous sulphate to 25 feet of row	10	4	2	2
		10	6	2	0
59 and 125	Untreated	10	8	2	3
	......do	10	10	2	6
60 and 126	Reserved for spring treatments, but sprayings were not made	10	14	2	8
		10	12	2	9
61 and 127	......do	10	0	1	14
	......do	10	12	2	4
62 and 128	......do	10	4	2	1
	......do	11	4	2	4
63 and 129	......do	11	8	2	6
	......do	11	0	2	1
64 and 130	......do	9	8	1	8
	......do	10	0	1	13
65 and 131	......do	11	4	2	3
	......do	9	10	1	12

In commenting upon this table, Mr. Bartholomew says:

The total weight of straw and grain on the entire tract was 1,528 pounds, the 62 untreated plats yielding 797 pounds, and the 58 treated ones 731 pounds. The average yield per plat for the former was 11.72 pounds and for the latter 11.32 pounds. The total yield of cleaned grain was 258 pounds, being 133 pounds for the untreated and 125 pounds for the treated.

The average yield on both classes was almost exactly the same, viz, 1.95 pounds per plat. This shows a difference in favor of the treated plats in the matter of grain when we consider that the average product of these plats was about one-third of a pound less per plat, and that a number of the plats were greatly injured by the treatment as indicated in the table, showing a marked decrease in the production of both grain and straw. Doing away with the passage ways between the plats and presuming the rows to be 9 inches apart over the whole tract, this would indicate a yield of about 17 bushels per acre, which is in marked contrast with the adjoining field, where the yield was 30 bushels. Of course in the field the conditions were quite different. The seed was sown broadcast among cornstalks and thoroughly cultivated in with a fine shovel cultivator, and stood very thick all over the ground.

Another rather peculiar thing must be noted regarding conditions. The preparation of the ground consisted in cultivating and thoroughly harrowing the land, which placed it in excellent condition for seeding. A good crop of corn was raised on the land. This was cut and carried off before the cultivating and harrowing. The whole plat was very smooth, so much more so, in fact, than the adjoining field, that it proved an excellent playground for dozens of jack rabbits. Many of the young plants were

actually pulled out by the roots by these animals. Had it not been for this aggravating cause I have no doubt that the yield in straw and grain would have reached an average of 13 pounds per plat.

My conclusions regarding the efficacy of the various treatments are easily drawn. I have little hesitancy in saying that the several soil and seed treatments, so far as the prevention of rusts are concerned, were practically valueless. The sulphur treatments were productive of good results in an increase of yield but with that the matter stops. The success, whatever there is of it, has been all attained through sprayings. While it is true that no plat was entirely free from rust, it is nevertheless a fact that its ravages were reduced to a minimum on the ten-day plats sprayed with Bordeaux mixture and ammoniacal solution of copper carbonate. I think the potassium sulphide solution should be discarded, as it seems to have a deleterious effect wherever applied. This was especially apparent, as will be noted, in Experiment B. Last fall I thought that the Bordeaux mixture when applied to very young plants had a deleterious effect, but my observations this season have led me to conclude that when properly applied no harm follows.

Experiment B.

The object of this work was to test the effect of eleven preparations as preventives of rust when applied to spring wheat and oats in the form of spray beginning when rust first appeared. The preparations used were as follows:*

Table 9.—*Showing the composition of the fungicides used.*

No. 26	Basic cupric acetate mixture:	
	Cupric acetate (refined powder)	47.6 grams.
	Water	15144.0 grams.
No. 27	Copper borate mixture:	
	Cupric sulphate	59.6 grams.
	Sodium borate (borax)	65.5 grams.
	Water	15144.0 grams.
No. 28	Cupric ferrocyanide mixture:	
	Cupric sulphate	59.6 grams.
	Potassium ferrocyanide (yellow prussiate of potash)	89.4 grams.
	Water	15144.0 grams.
No. 29	Cupric hydroxide mixture:	
	Cupric sulphate	59.6 grams.
	Potassium hydrate	107.2 grams.
	Water	15144.0 grams.
No. 30	Tricupric orthophosphate mixture:	
	Cupric sulphate	59.6 grams.
	Sodium phosphate	104.2 grams.
	Water	15144.0 grams.
No. 31	Cupric polysulphide mixture:	
	Cupric sulphate	59.6 grams.
	Potassium sulphide (liver of sulphur)	59.6 grams.
	Water	15144.0 grams.
No. 32	Ferrous ferrocyanide mixture:	
	Ferrous sulphate exsiccatus	91.7 grams.
	Potassium ferrocyanide	183.5 grams.
	Water	15144.0 grams.
No. 33	Iron borate mixture:	
	Ferrous sulphate exsiccatus	91.7 grams.
	Sodium borate (borax)	367.0 grams.
	Water	15144.0 grams.
No. 34	Iron sulphide mixture:	
	Ferrous sulphate exsiccatus	91.7 grams.
	Potassium sulphide (liver of sulphur)	367.0 grams.
	Water	15144.0 grams.
No. 35	Zinc borate mixture:	
	Zinc sulphate	133.4 grams.
	Sodium borate (borax)	133.4 grams.
	Water	15144.0 grams.
No. 38	Bordeaux mixture, weak strength:	
	Cupric sulphate	10.4 grams.
	Lime (stone)	2.5 grams.
	Water	15144.0 grams.

* The numbers here are the original ones given by my assistants to the preparations for convenience of reference.

In addition to the foregoing there was one soil and seed treatment with Bordeaux mixture, the seed being immersed for twenty-four hours in the preparation and the soil treated with one-half gallon of the mixture to 20 feet of row. For the experiment as a whole 100 plats, each 3 by 15 feet, were used. Fifteen of the plats were planted with wheat and the same number with oats. For seed, White Mediterranean wheat, and Black Winter oats were used, each being planted on April 8, 1892. On June 4 *Puccinia rubigo-vera* was noticed on a few plants of wheat, thereupon each plat received the following treatment:

TABLE 10.—*Showing kind of treatment given each plat in Experiment B.*

Plat.	Kind of treatment.
1 and 1	No treatment.
26 and 26	Sprayed with basic cupric acetate mixture.
2 and 2	No treatment.
27 and 27	Sprayed with copper borate mixture.
3 and 3	No treatment.
28 and 28	Sprayed with cupric ferrocyanide mixture.
4 and 4	No treatment.
29 and 29	Sprayed with cupric hydroxide mixture.
5 and 5	No treatment.
30 and 30	Sprayed with tricupric orthophosphate mixture.
6 and 6	No treatment.
31 and 31	Sprayed with cupric polysulphide mixture.
7 and 7	No treatment.
32 and 32	Sprayed with ferrous ferrocyanide mixture.
8 and 8	No treatment.
33 and 33	Sprayed with iron borate mixture.
9 and 9	No treatment.
34 and 34	Sprayed with iron sulphide mixture.
10 and 10	No treatment.
35 and 35	Sprayed with zinc borate mixture.
11 and 11	No treatment.
38 and 38	Sprayed with Bordeaux mixture.
12 and 12	No treatment.
24 and 24	Soil and seed treatment with Bordeaux mixture.

Additional sprayings were made on June 6, 16, and 20, and July 5, respectively. The oats were harvested on July 16 and the wheat two days later. Mr. Bartholomew furnished the following notes on the effect of each treatment, the numbers given being those of the preparation and not the plats:

The condition of the untreated plats with respect to rust was very similar to those in Experiment A, all being quite uniformly affected with the fungus. The total yield for the 26 untreated plats was as follows:

Straw and grain	pounds	89½
Cleaned grain	do	13¾
Straw and grain per plat	do	3⅛
Cleaned grain per plat	ounces	8½

No. 26.—Basic cupric acetate mixture. Almost *entirely* free from rust; yield considerably above the average, viz, 4 pounds, and 4 pounds, 10 ounces per plat. The adjoining untreated plats were covered with red rust from bottom to top.

No. 27.—Copper borate mixture. Very similar to 26, being free from rust and the yield above the average.

No. 28.—Cupric ferrocyanide mixture. Below the average in yield, being injured by the fungicide; straw and grain light; can not recommend this preparation.

No. 29.—Cupric hydroxide mixture. Yield above the average and remarkably free from rust.

No. 30.—Tricupric orthophosphate mixture. The same as the last.

No. 31.—Cupric polysulphide mixture. Quite free from rust and produced the best yield on the tract, viz, 4 pounds, 8 ounces, and 4 pounds, 10 ounces per plat.

No. 32.—Ferrous ferrocyanide mixture. A practical failure, yielding very lightly in straw and almost no grain. This preparation should certainly be discarded. It is, however, a good weed destroyer, and would be good where weeds or grass are to be kept permanently down about trees or shrubs. No weeds came up on these plats after harvest, while on all the rest more or less weeds appeared.

No. 33.—Iron borate mixture. Yield normal, but plats considerably rusted. Would not recommend this preparation.

No. 34.—Iron sulphide mixture. A decided failure, producing very unsatisfactory results. If full strength had been used scarcely a green stalk would have been left by the fourth spraying, but after the second spraying the preparation was used half strength and was even then too severe. Very little rust.

No. 35.—Zinc borate mixture. Yield good; quite free from rust, though not as perfectly free as some of the preceding numbers.

No. 38.—Bordeaux mixture. Yield of straw good, but grain light. My experience with Bordeaux is that it has a decided effect on the common red rust as indicated, not only in this experiment, but in "A" also. These plats were nearly free from rust.

No. 24.—Seed immersed 24 hours in Bordeaux; one-half gallon of the mixture to 20 feet of row for soil; treatment showed as much rust as any untreated plat. The product was above the average in straw and grain.

One thing particularly noticeable at the time of threshing was the fact that in such treatments as 26, 27, 29, 30, 31, and 38 the lower leaves were full and abundant, while in the untreated plats they were mostly thin, shrunken, or fallen off. Could these results be made to obtain throughout a field, it occurs to me that the feeding value of a ton of straw would be greatly increased. As a whole, these experiments were far more satisfactory than those described under "A."

In the following table the yield of the several treated spring wheat plats is given:

TABLE 11.—*Showing method of treatment and yield of grain and straw.*

Plat.	Kind of treatment.	Yield of grain and straw.		Yield of cleaned grain.
		Pounds.	*Ounces.*	*Ounces.*
26 and 26	Sprayed with basic cupric acetate mixture	4 4	0 10	10 12
27 and 27	Sprayed with copper borate mixture	4 4	3 6	9 9
28 and 28	Sprayed with cupric ferrocyanide mixture	3 3	2 8	6 8
29 and 29	Sprayed with cupric hydroxide mixture	3 4	12 0	8 9
30 and 30	Sprayed with tricupric orthophosphate mixture.	4 4	0 4	9 11
31 and 31	Sprayed with cupric polysulphide mixture	4 4	10 8	10 11
32 and 32	Sprayed with ferrous ferrocyanide mixture	3 3	4 0	7 6
33 and 33	Sprayed with iron borate mixture	3 3	0 8	7 8
34 and 34	Sprayed with iron sulphide mixture	3 3	6 3	7 6
35 and 35	Sprayed with zinc borate mixture	4 3	2 12	10 10
38 and 38	Sprayed with Bordeaux mixture	3 4	14 6	8 9
24 and 24	Soil and seed treatment with Bordeaux mixture	4 3	2 10	9 8

It appears from the foregoing that the total yield of straw and grain on the 24 treated plats was 82 pounds, an average of 3.41 pounds per plat. The total yield of cleaned grain was 13 pounds, an average of 8¾ ounces per plat. The total averages in this case do not differ materially from those where no treatments were made. It should be borne in mind, however, that there were 2 more plats in the untreated lot than in the treated; also, that a number of the treated plats were so seriously injured that the yield was very light. Taking out of consideration the reduction in the crop due to the foregoing causes, the treated plats gave a somewhat higher average yield than the untreated.

The results in the treatment of oats were wholly negative, as no rust whatever appeared on any of the plats. It may be of interest to say, however, that several of the preparations, notably Nos. 32 and 35, seriously injured the plants. As a result of this the yield of the treated plats was nearly 10 per cent less than the untreated.

Experiment C.

Experiment C consisted of spraying 1 plat each of late-planted spring wheat and oats with Bordeaux mixture, full strength, combined with soap. It was thought that possibly rust would not appear in experiments A and B; consequently the late spring grains, which are almost invariably attacked by the disease, were put in. Each plat was 33 feet long and 3 feet wide, there being 2 in each case, 1 for treatment and 1 for control. The sowing was not done until May 20, but the weather was so warm that the plants were well up by the 30th of the same month. Six treatments in all were made, the dates being May 30, June 3, 6, 16, and 25, and July 5, respectively. No rust of consequence appeared on any of the plats, consequently the results so far as concerned the prevention of this disease were negative.

CONCLUSION.

The work described in the foregoing pages, carried on under widely different conditions of soil and climate, seems to clearly indicate that treating the seed and soil previous to planting with various chemicals and with hot water is of no value whatever so far as the prevention of rust is concerned. This accords with our knowledge of the life history of the rust fungi attacking cereals, and bears out the generally accepted belief of those who have studied the matter. Many of the soil and seed treatments were positively injurious, diminishing the crop to a far greater extent than all the diseases observed combined.

The spraying treatments did, in some cases at least, diminish the amount of rust and seemingly increased the yield of straw and grain. A slight increase of yield in an experiment of this kind, however, must be looked upon with a good deal of suspicion, as there are many things that might influence the matter one way or another. On the whole

there seems no good reason for believing that spraying, even with the most improved methods with which we are now familiar, would be practicable or profitable on a large scale. At Garrett Park, where this kind of work was done with the greatest care and where every precaution was taken to make the various preparations cover the foliage, rust was just as abundant on the sprayed as on the unsprayed wheat. A critical study of the plants in the field afforded what seems a satisfactory explanation of the foregoing fact. On examining the leaves immediately after they had been sprayed in the most careful manner, it was found that fully one-half of the surface was wholly free from any signs of the liquid put on. The shape of the leaf, its position on the stem, manner of growth, and waxy covering, all conspire to render it exceedingly difficult to wet, and unless thoroughly wetted or covered by the fungicide there is little hope of preventing the reproductive bodies of the rust fungi from gaining an entrance.

Finally, it may be said that while improved machinery and fungicides and improved methods may make it possible to profitably spray our cereals, with our present means this can not be done. The work, however, should not be abandoned: on the contrary, it should be continued until the matter is definitely settled one way or the other. At the same time the far more promising work of breeding rust-resisting varieties should be taken up and carried forward along such lines as offer the most promising results.

ADDITIONAL NOTES ON PEACH ROSETTE.

By Erwin F. Smith.

I.—SPREAD OF THE DISEASE.

The peach rosette continues in Georgia and has appeared in South Carolina. Mr. W. L. Anderson, of Ninety-six, sent specimens from his peach orchard, and wrote as follows, under date of June 14, 1892:

> In the summer of 1890 I noticed some of the peach trees turning yellow; but, from information at hand, concluded it was not what is called the yellows. The trees (3) died, root and branch. No sprouts have ever put forth from the old roots of any of these or other trees since attacked. Last year I lost 6 trees from the same disease. This year I cut down 8 as soon as I noticed the peculiar growth of the leaves. I have 2 left, some one-fourth mile apart. They are, at this writing, evidently moribund and will be dead in another month.

Mr. Anderson states that several of his neighbors have lost trees, and that the disease is entirely new to him, although he has lived in that region and been interested in peach-growing for a long time.

Some field work begun in Georgia in 1890 and 1891, could not be reported upon fully in Bulletin 1,* because incomplete or only just begun

* Div. Veg. Pathology, U. S. Dept. of Agr., 1891.

when that report went to press. A year has passed and certain additional conclusions may now be drawn with confidence.

The experiments are as follows:

II.—FIELD EXPERIMENTS IN GEORGIA.

I. *Peach on Marianna plum stock—Buds from the healthy-looking side of a rosetted peach tree.*—This experiment was made to determine whether the disease was latent in the healthy-looking side of the affected trees, and would afterwards appear in buds cut from the same and inserted into healthy stocks. The buds were set July 1. 1890. The condition up to the fall of 1891 of the trees grown from these buds is given under Experiment 2 (Bull. No. 1, p. 56). These trees were reëxamined October 31, 1892. All of them were still free from rosette. The buds have now been set twenty-eight months and have grown into vigorous tops, so that there can no longer be any doubt that the north part of the parent tree was entirely free from taint of disease at the very time that the south part was badly affected. The rest of this tree became diseased the following season and is now dead.

II. *Marianna plum stocks inoculated with buds taken from rosetted peach trees.*—This experiment was made to determine whether the peach and plum rosette are identical. For this experiment and the next about 250 trees were selected from 5 nursery rows on the farm of William Warder, Griffin, Ga. These trees were propagated from cuttings and were 1½ years old at the beginning of the experiment. Two rows were inoculated and 3 were held for comparison. June 8, 1891, 104 of these trees were inoculated with buds cut from 6 or 8 of the badly rosetted young trees described in Experiment 1 (Bull. No. 1). One to two buds were inserted into each tree in the usual way. November 13, 1891, all were free from rosette. At that time the condition of the inserted buds was as follows: In 42 trees the buds had healed on and were still alive in whole or part, but only 2 had grown into shoots, and both were feeble—only ½ and 1 inch long. In 2 or 3 trees the unions were doubtful. In the rest the buds failed to unite with the stocks. There is no question, therefore, but that in more than one-third of the trees an organic union had taken place between the plum stocks and the rosetted buds. Only five months had elapsed and it was thought that perhaps a longer period might be necessary to infect plum from peach than had been found necessary in case of peach on peach. These trees were reëxamined November 1, 1892, *i. e.*, more than sixteen months from the date of inoculation, and all were still free from rosette. There is, therefore, good reason to believe that the Marianna plum is not subject to this disease.

III. *Marianna plum stocks inoculated with buds taken from a rosetted Kelsey plum.*—This experiment was made to determine whether the plum rosette could be transmitted to plums. The trees used for these

experiments formed part of the block described under II. The buds were inserted the same day under like conditions. They were taken on the Wayman farm, from a Kelsey plum which was badly affected in all parts. Only 12 trees were budded. On November 13, 1891, it was found that the diseased buds had healed on to 4 trees, and were still living. On the others they had been thrown out. There were no cases of rosette. The trees were reëxamined November 1, 1892. All were free from rosette. This is the only experiment yet undertaken to determine whether this disease can be transmitted from plums to plums.

IV. *Peach stocks inoculated with buds taken from rosetted Kelsey plums.*—This experiment was made to determine whether the plum rosette could be transmitted to peach trees. Two rows of nursery trees, 37 in all, consisting of Elberta tops on seedlings of the same age as in V, were selected for this experiment. This formed part of the nursery described in Experiment 1 (Bull. No. 1). Scions were cut from two badly diseased Kelsey plums, which stood on the same farm about ½ mile distant. The inoculations were made June 20, 1891, and two buds were inserted into each stock. November 12, 1891, an examination showed that some part of one or both buds had united with the stock in 22 cases, and was still alive. In 3 trees the union was doubtful, and in 12 both buds failed to unite. At this date all were healthy with exception, possibly, of 1 tree, which had begun to look suspicious. The inoculated buds were very feeble, and in no case did they grow into branches. Here, then, an organic connection was established between the buds and stocks in two-thirds of all the trees. October 29, 1892, these trees were reëxamined with the following result: Many of the buds which had healed on were still alive. Two trees were dug out in summer, and may have shown symptoms of rosette, but this is doubtful. One of these was the tree marked as suspicious in the fall of 1891. Two trees developed rosette in the spring, in all parts, and died in August. The rest were healthy in spite of the fact that sixteen months had passed since the insertion of the diseased buds. Both the rosetted trees were inoculated from the same plum; both the missing trees from the other plum.

The small per cent of cases to unions makes it necessary to repeat this experiment before it can be stated positively that the plum disease is identical with that of the peach and transmissible to it, as seems very probable from its appearance.

V. *Root inoculations, peach on peach.*—This experiment was made to determine whether the disease could be transmitted from roots to roots, and incidentally to throw some light on the possibility of natural infection through the soil. Sixty young trees were selected for this purpose. They stood in the same nursery and were planted the same time as the five rows inoculated in 1890 and described in Experiment 1 (Bull. No. 1, p. 49), but bore Elberta tops. The collars of the trees in two rows were uncovered and all trees badly infested by borers were destroyed.

The remainder were then inoculated, June 20, 1891, as follows: The earth was carefully removed from one of the roots and a T-shaped incision was made down to the pericambium. A root about $\frac{1}{4}$ inch in diameter was then selected from a rosetted tree and a curved cut made through the bark down to the pericambium, parallel to it for about an inch, and then out again, in some cases including a thin shaving of wood. This graft was then crowded beneath the lips of the T-shaped cut and bound into place. The earth was then returned. These root grafts came from 15 badly rosetted trees, and each one was taken from a separate root. Each tree furnished 4 grafts, making a total of 60. Presumably all of these roots were diseased, but such is not known to be the case. The inference rested on the fact that all of the leaves and shoot-axes were rosetted on each of the 15 trees. Nine of these trees were from Experiment 1 (Bull. No. 1), being seedlings in which the disease had been produced by the previous year's bud inoculations. The other 6 trees stood in a neighboring orchard, were 5 or 6 years old, contracted the disease naturally, and had been entirely healthy until the spring of 1891. The bark of the roots being much thicker than that of stems of the same size, considerable difficulty was experienced in getting the grafts into place, and consequently it was somewhat doubtful whether they would unite with the stock.

These trees were examined November 12, 1891, *i. e.*, four months and twenty-two days after the inoculation. All were free from rosette and healthy.* They were reëxamined October 31, 1892. The conditions above ground were as follows: Seven trees were rosetted in all parts and already dead, 52 trees were healthy, 1 had been killed by borers and termites. All of the rosetted trees were grafted from the artificially infected young trees. The 24 trees grafted from the naturally infected orchard trees remained sound. Three of the 7 rosetted trees were grafted from 1 tree, the other 4 were grafted from 4 other trees, making five sources of infection. After the above-ground conditions had been determined, the roots of each of the 60 trees were dug out, washed, and carefully examined. Although the grafting had taken place more than sixteen months previous, it was not difficult to find the scar, and in most cases the inserted graft was still in place. The result of this examination may be summed up as follows: In the 7 rosetted trees the inserted graft had healed on and become an organic part of the root. In 5 healthy trees a very small fragment of the graft may have healed on, but this was doubtful, and can only be settled, if at all, by microtome sections and a careful study. The remainder of the graft was unquestionably thrown out. In the rest, the inserted grafts wholly failed to unite with the root, but were generally in place in a shriveled or semi-decayed condition, the roots having healed under them.

The symptoms appeared on the rosetted trees in the spring—April

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*In case of the above-ground inoculations of Experiment 1 (Bull. No. 1), more than 50 per cent of the trees developed symptoms in four months and twelve days.

or May. All of them showed symptoms at once in all parts, and all died in August. There were and have been no cases of rosette in the rest of the young Elbertas (about 4,000); there was only one case in that part of the orchard joining this nursery, and there were less than last year in the other orchards on this farm, *i. e.*, about 27 in a total of 10,000 trees. This makes it overwhelmingly probable that the results here detailed are to be ascribed to the inoculations and not to any outside influence.

This experiment is especially interesting for a number of reasons:

(1) The disease has now been communicated from artificially infected trees to healthy ones, *i. e.*, the infection has been carried a second remove from the orchard trees which were its original source. (Bull. No. 1.)

(2) The rosette can be communicated from root to root as well as from stem to stem.

(3) The root-inoculated trees did not develop symptoms as soon as those which were inoculated above ground the preceding year, probably because the contagion had a longer distance to travel through the tissues.

(4) The small per cent of infections in comparison with the results of 1891 (Bull. No. 1) is attributable to the smaller number of unions. There were unions on only 12 trees at most and the disease followed in every case where from one-half to the whole of the graft became firmly united to the root.

(5) In case of the five doubtful unions the grafts came from as many different trees, and it is possible that these fragments may not have contained the infectious material even if any part really united with the roots, which is also a matter of doubt.

(6) In the other 52 trees, as in 4 trees of Experiment 1, (Bull. No. 1), simple contact failed to induce the rosette, although in all cases the diseased tissue (young prosenchyma and pericambium) was bound down tightly on to the meristem of the root, and in several instances was found to have been inclosed and tightly squeezed, and even deeply buried between the growing tissues of the root.

VI. *Inoculations of young peach trees with micro-organisms derived from cultures.*—These experiments were made to determine whether micro-organisms were constantly or commonly present in diseased tissues, and whether pure cultures of any of them would induce the rosette. Numerous tube and plate cultures from rosetted trees were made at Griffin, Ga., by W. T. Swingle and myself, in the summer of 1891, with as great care as our limited facilities would permit. A number of interesting yeasts and bacteria were isolated from the tissues or appeared in the cultures as contaminations. Notes were made on the manner of growth and microscopic appearance, stained and unstained, of all these forms—about twenty—and pure cultures from the original colonies were used for purposes of inoculation.

A series of 20 young trees was inoculated on the farm of H. W. Hasselkus, east of Griffin, and a duplicate series was inoculated on the farm of J. D. Husted, at Vineyard. Some of the more promising organisms, *e. g.*, those which grew but feebly on the agar or gelatine, and those which occurred in the cultures most frequently, were also inserted into a row of young trees in the garden of Mr. Hasselkus in Griffin. Each tree was inoculated on the main axis above ground in three places and in three slightly different ways, as follows:

(1) A T-shaped slit was made through the bark, and one flap was separated from the cambium and slightly lifted. A mass of the organisms was then removed from the culture on the loop of a platinum wire and inserted into the wedge-shaped cavity between the wood and bark. The latter was then bound securely in place.

(2) Into a similar slit a bud cut from the same tree was inserted and bound in place as in ordinary budding, the inner bark of the bud having first been carefully smeared with the micro-organisms, so that bark of insert and wood of stock were brought into close contact with a thin layer of germs between.

(3) The third inoculation was made in the same way, *i. e.*, the inner surface of the insert was smeared with the germs, but the wood of the bud was not removed.

The platinum wire was flamed before each inoculation, and the work was carried on as rapidly and deftly as possible to avoid contaminations. The inoculations were made in Mr. Hasselkus's yard June 15 and 16, on his farm June 19, and at Mr. Husted's place June 22, 1891. These trees were examined in the fall of 1891, and again in the fall of 1892. None of them developed rosette or any symptoms suggestive of it. In some cases there was considerable swelling and flow of gum at the points of inoculation, but none of the trees died or became sickly. All of the trees made a good growth, and those belonging to Mr. Hasselkus grew enormously. Of course many of the buds were thrown out, but others healed on in spite of the coating of micro-organisms.

An experiment was also tried using scrapings and bruised fragments of diseased tissues as infective material, but it was in old trees on a small scale, and the results are not conclusive enough to make it worth reporting.

III.—CONCLUSIONS RELATIVE TO THE NATURE OF THIS DISEASE.

(1) Excluding a few doubtful cases, the disease was conveyed from peach to peach whenever an organic union took place between the diseased buds and the healthy stocks (two experiments—128 trees).

(2) In no case was the disease transmitted artificially by mere contact even when meristem was bound very closely to meristem (two experiments—56 trees).

(3) From the failure to induce rosette by simple contact it is prob-

able that the contagion does not enter the tree through ordinary wounds caused by men or animals.

(4) The fact that the disease can be transmitted artificially through the root system makes it probable that trees may also become infected naturally in this way.

(5) Experimental proof of the identity of the peach rosette and the plum rosette is still incomplete.

(6) None of the yeasts or bacteria found in the cultures made from diseased tissues produced the disease when inserted into the cambium, and it is probable that the disease is not due to such organisms.

(7) In both natural cases and those induced by budding, the disease progresses gradually from the point of infection until all parts of the tree are involved. Even when a tree shows symptoms in all parts at once, as is very often the case in early spring, we may assume that the cause of infection entered through the roots during the previous summer or autumn and was gradually diffused through the whole tree in the months immediately preceding the vernal symptoms, as was certainly the case in the seven root-grafted trees.

(8) The shortest period of incubation was about two months (Bull. No. 1, p. 49) and the longest period about ten months, but one-half of this longest period was the winter season, during which the trees were dormant.

(9) The disease is probably conveyed through the protoplasm and the failure to isolate any pathogenic yeast or bacterium suggests the possibility that the cause is some amœboid organism living in the protoplasm and so much resembling it as to be difficult of detection. Such an hypothesis would explain all the facts. That the disease is due to any chemical ferment or other readily soluble substance seems out of the question, for the upward and side movements of the water imbibed by the roots would certainly carry it to all parts of the growing tree within a few hours or a few days at longest. Moreover, such a substance possesses no indefinite power of multiplication. Whereas, in this disease a very small fragment will induce symptoms in a whole tree, any part of which will then induce the disease in another tree.

REMEDIES FOR THE ALMOND DISEASE CAUSED BY CERCOSPORA CIRCUMSCISSA, SACC.

By Newton B. Pierce.

[Plates XVIII–XX.]

Since the publication of the author's former paper on the almond disease so prevalent in southern California,* spraying experiments have been conducted in Orange County, which have clearly demon-

*Journal of Mycology, Vol. VII, No. 2, pp. 66–77.

strated that the disease may be controlled at moderate expense and in a thoroughly satisfactory manner. The suggestions of B. T. Galloway in regard to the treatment of this disease have proven of value.* From experiments now completed, and from additional facts gathered in relation to the habits of the parasite, there may now be outlined a very satisfactory plan of treatment.

The trees selected for the experiments were on the place of J. S. Baldwin, about 1 mile east of the village of Orange. They were badly infested by *Cercospora* in 1891, and had lost nearly all of their foliage by the latter part of July. By the 1st of August, 1892, the untreated trees were in worse condition than at the same date the preceding year, and only a few shoots had developed during the spring. There were 34 trees included in the experiment, and they formed a single row about 800 feet long, running from west to east through an orchard composed of various fruits. They were twelve years old and were grown on a soil of gray loam mixed with more or less gravel. The care given them has been but moderate. Many of the tops were well formed and of good size, while others were smaller and stunted in growth, owing to poorer soil. The branches, with the exception of a few terminal ones, were alive, but up to August 1 but little growth had been made and most of the wood of last season's growth was ready to die back. These trees leafed out fully in the spring of 1892 and received the first treatment in April.

Prior to the beginning of this season's work the almond foliage was supposed to be annually infected in the early spring by spores which came mainly from the fallen leaves of the previous year's growth. It has since been learned that infection of the spring foliage is mainly accomplished by means of spores produced on the terminal twigs of the tree, *i. e.*, on the last season's shoots. There is some evidence also that *Cercospora* may become nearly or quite biennial in its habits when living on almond branches. It even appears probable that in some cases it lives in the tissues of the twig through the mild winters of southern California and produces in the following spring a sufficient number of spores to infect the new foliage. Some observations seem to point to even a perennial life for the fungus, in rare cases. Be this as it may, it is evident from the way the tree first shows the disease in the spring that the new terminal leaves are infected directly from the last year's wood. Branches on all parts of the tree show disease first on the leaves at the end. This is as true of the uppermost limbs as of those next the ground, which would not be the case if the infecting spores came from either fallen foliage or the soil.

The spring infection is usually general over the outer branches, but in many cases it is more complete and the work of the fungus shows earlier on the north than on the south side of the tree. This may arise in part from the greater humidity on the north, due to shade, and the conse-

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Ibid., pp. 77–78.

quent conditions favorable to germination, and from the fact that the prevailing winds are from the southwest and naturally blow more spores to the north side of the tree.* It has already been noted that five-sixths of the infested points on the branches occur on the lower two-thirds. This is in harmony with the above facts, and arises from a like reason—the greater humidity on the shaded side.

After the parasite has become well developed on the outer leaves infected from the terminal twigs and abundant spore clusters are formed, the foliage toward the center of the tree becomes infected. The parasite spreads from the terminal leaves to those at the base of the limbs, and the fall of the diseased foliage follows essentially in the same order, although as the basal leaves are the older their fall is in consequence somewhat hastened.

From the preceding facts it will be seen that sprays applied after the outer leaves are infected, but before the fungus has matured fruit, may still prevent its spread to the main mass of foliage in the center of the tree. It is equally evident that if infection of the outer leaves is to be prevented the first application of fungicides should be made to the spore-bearing terminal twigs before the blossoms and new leaves have appeared. By this last method the spring infection of the leaves will be in the main prevented and the fungicide on the terminal twigs will destroy the germinating spores that have been formed there.

As it was not known in time that infection of the spring foliage was from the terminal twigs, the first application of sprays was not made until April 15, after the leaves were well formed. Hence some of the end leaves were infested before the fungicides were applied. In consequence of this a small proportion of these end leaves fell off, but most of the foliage on the end shoots was retained, and nearly all of it over the major part of the tree. In applying the fungicides it was planned to have 2 treated trees alternating with 2 untreated ones. This gave control trees equal in number to those treated, while treated and untreated trees were equally representative of the whole.

Two fungicides were used:

(1) Ammoniacal solution of copper carbonate. The treated trees in the west half of the line received this spray.

(2) Modified eau celeste. This was used for treatment of the trees in the east half of the line. These were mostly larger than those at the west.

These two fungicides were made as follows:

Ammoniacal copper carbonate.†—In a wooden pail 5 ounces of copper

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**Ibid.*, Vol. VII, No. 2, p. 69.

†When copper carbonate can not be had of dealers it may be made at home, and usually at less than the market cost. For directions for making see Journal of Mycology, Vol. VII, No. 2, pp. 77–78. Also Farmers' Bulletin No. 7, p. 12. The latter may be had from the Secretary of Agriculture.

carbonate was dissolved in 3 pints of concentrated ammonia (26°). This solution was diluted with 45 gallons of water.

Modified eau celeste (*new formula*).*—In 10 to 12 gallons of water 4 pounds of copper sulphate (crystals) were dissolved. To this solution was added 3 pints of concentrated ammonia (26°), and after stirring, this was diluted with water to 40 gallons. To this was added 6 to 8 gallons of water in which had previously been dissolved 5 pounds of sal-soda.

A cart sprayer holding about 50 gallons was used in these experiments, but for general field work a wagon tank similar to tanks in general use through southern California for the treatment of orange diseases, may be used. The pump should be of brass and kept well oiled, as the action of one of these sprays on metal is marked. The two lengths of spray hose should be about 24 feet long. To the free end of the hose was attached a piece of brass pipe 6 to 8 feet long and $\frac{5}{8}$ of an inch in diameter. This pipe is light, not easily affected by the fungicides as is the iron tubing, and is fitted with a stopcock so that the flow may be checked at any moment. To the end of the tube is fitted the Nixon nozzle. When applying the ammoniacal copper carbonate the No. 3 nozzle of this make works well; but it has been found that the brass netting used will not withstand the modified eau celeste. It is eaten through in a few moments and a suitable spray is no longer formed. The manufacturers have given assurance that they will have nozzles fitted with aluminium wire cloth the coming season, and this will probably withstand all mixtures suitable for fungicides.

It is very important that the mixtures be applied as a fine spray. When too coarse, the spray will collect in quantity on the leaves, and as a result they are burned. Further, there is a great loss of the fungicide when too coarse sprays are applied. Calm weather should always be selected for the treatment. In windy weather the trees will require nearly twice as much of the fungicide to properly reach all parts, and the work will not be done with the desired uniformity. With two length of hose 4 trees may be treated at each stand of the spray tank—2 on each side. All parts of the tree should be very thoroughly treated, both surfaces of the leaves as well as all of the branches. The light brass tube used is of great assistance in reaching the interior of the tree as well as the uppermost branches.

PLAN OF TREATMENT AND RECOMMENDATIONS.

The trees included in these experiments were numbered from west to east. Trees numbered 1, 2, 5, 6, 9, 10, 13, 14, 17, 18, and 19 were sprayed on April 15 with the ammoniacal solution of copper carbonate. Trees numbered 3, 4, 7, 8, 11, 12, 15, 16, 20, and 21 were left untreated.

* Differs from the ordinary modified eau celeste in the fact that ammonia is added before the sal soda.

The treated trees required about 2½ gallons of the fungicide at the time of the first treatment, as they were then in full leaf. When work was begun there was considerable wind blowing. Had it not been for this, 2 gallons of spray would have done equally good work. The time required to spray was eight to ten minutes for each tree. In calm weather five to eight minutes would be sufficient for a tree in full leaf, and four minutes for a tree not yet in leaf. The treated trees were carefully observed and it was not thought necessary to spray a second time until May 12. They were then treated with the same fungicide. This was the last treatment made, as the foliage retained the copper salts remarkably well and no heavy rains occurred later.

Trees numbered 22, 23, 26, 27, 30, 31, and 33 were first treated with the modified eau celeste on April 15. Trees numbered 24, 25, 28, 29, 32, and 34 were left untreated. The tops of the trees treated with this fungicide were, on the average, much larger than those treated with the ammoniacal copper carbonate. From 2½ to 3 gallons of fungicide would be required for such trees if the work be conducted in still weather and the spray be fine. In the present experiment there was considerable wind blowing, and the nozzles were imperfect because of the action of the sprays on the tip. Hence more fungicide was used than would otherwise have been required. About eight minutes were consumed in spraying each tree thoroughly.

After the first treatment there came a heavy rain. Nearly or quite 2 inches of water fell. Shortly afterward the trees were examined carefully, and it was found that the leaves were still well covered with the copper salts. A second thorough spraying was made with the same fungicide on May 12. From that time on the weather was dry, and the foliage and limbs of the treated trees retained the copper so perfectly that no other sprayings were necessary. As late as August 3 the mixture showed distinctly on all parts of the treated trees. It thus appears that modified eau celeste is an admirable spray to adhere, and in this dry climate, after the close of the winter rains, fewer treatments of plants are needed than in the East, where summer rains occur.

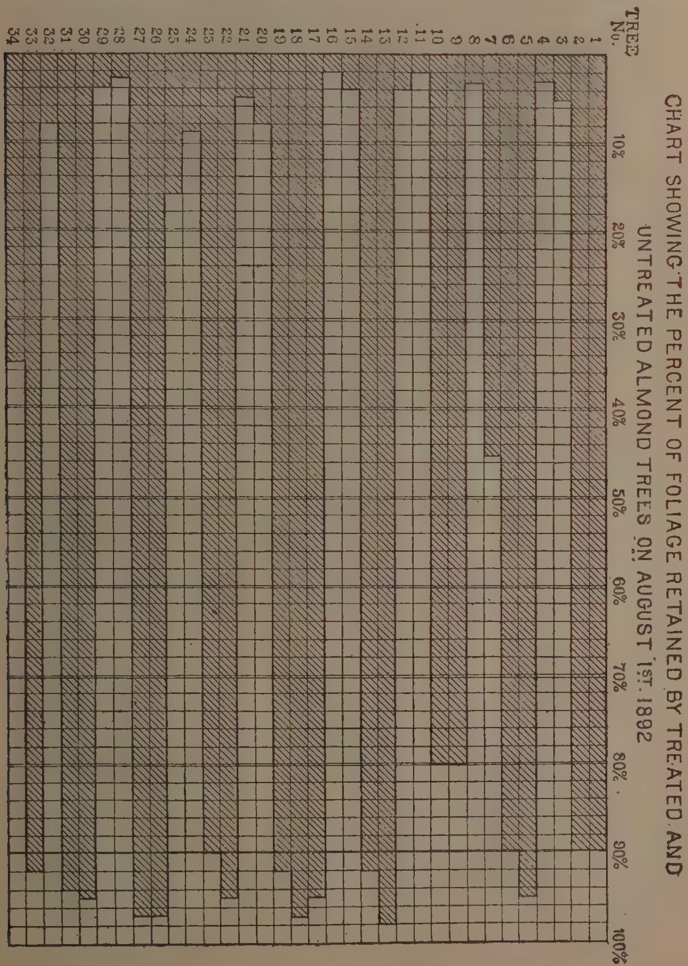
By June 14, the action of both the preceding sprays was evident. The leaves on untreated trees were becoming badly infested. The leaves on the outer twigs of the treated trees were also somewhat affected, but this was where infection had taken place from the branch previous to the first spraying. The main mass of foliage on nearly all treated trees was in excellent condition. On July 14 the results of the treatment were still more evident. The treated trees retained most of their foliage, while the untreated ones were rapidly becoming bare. Treated and untreated trees could be distinguished from a great distance. By August 1 the untreated trees were nearly bare, while the treated ones were yet in full leaf, with the exception of a few terminal twigs.

On August 3 an examination of the entire 34 trees was made and the percentage of the foliage remaining on all the trees was carefully estimated. The following table gives the results of this examination:

TABLE 1.—*Showing condition on August 3 of treated and untreated almond trees, sprayed with ammoniacal copper carbonate solution.*

No.	Treatment.	Per cent of foliage.	No.	Treatment.	Per cent of foliage.
1	Treated	90	12	Untreated	4
2	......do	90	13	Treated	98
3	Untreated	5	14	......do	92
4	......do	3	15	Untreated	4
5	Treated	95	16	......do	2
6	......do	90	17	Treated	95
7	Untreated	45	18	......do	97
8	......do	3	19	......do	92
9	Treated	80	20	Untreated	8
10	......do	80	21	......do	5
11	Untreated	2			

The results are shown in a graphic form in the accompanying figure:



Here are shown the satisfactory results arising from the use of the ammoniacal solution of copper carbonate. The 11 sprayed trees retained from 80 to 98 per cent of the foliage, the average being 91 per cent. On the other hand, the 10 untreated trees, with one exception, had not retained more than 8 per cent of the foliage. The one exception, apparently a tree not badly infested by *Cercospora*, had still upon it about 45 per cent of its foliage. The foliage remaining on the 10 control trees averaged 8 per cent, but exclusive of the one exceptional tree it averaged only 4 per cent.

TABLE 2.—*Showing condition on August 3 of treated and untreated almond trees, sprayed with modified eau celeste, new formula.*

No.	Treatment.	Per cent of foliage.	No.	Treatment.	Per cent of foliage.
22	Treated	95	29	Untreated	4
23	do	95	30	Treated	95
24	Untreated	8	31	do	94
25	do	14	32	Untreated	8
26	Treated	97	33	Treated	92
27	do	97	34	Untreated	35
28	Untreated	3			

This table shows as good results from treatment with modified eau celeste as resulted from the use of ammoniacal copper carbonate. The 7 treated trees retained from 90 to 97 per cent of the foliage, the average being 94 per cent. The 6 untreated trees, with one exception, as in the former case, retained only from 3 to 14 per cent of their leaves. The exceptional tree in this case retained about 35 per cent of its foliage. Including this 1 tree, the average foliage on the untreated trees was 12 per cent, but exclusive of this tree it dropped to 7 per cent.

By comparing the trees treated with fungicides, we see that 91 per cent of foliage was preserved by the use of ammoniacal solution of copper carbonate, while 94 per cent was retained by using the modified eau celeste. This is so trifling a variation that it may be accounted for by the fact that the trees at the east, which were sprayed with eau celeste, are on better ground, are larger, and more healthy than those at the west, which were sprayed with the ammoniacal copper carbonate. These more favorable conditions show as well on the untreated trees as on the treated ones. The average amount of foliage retained on the untreated trees at the east was 3 per cent greater than that of the untreated trees at the west. This, curiously enough, is the difference in per cent of foliage on the treated trees at the east and on those at the west, which would seem to indicate that the action of the two sprays is almost exactly the same. If there exist any advantage of one spray over the other, so far as effectiveness as a fungicide is concerned, the advantages have not manifested themselves thus far.

Had the first treatment of these trees been made in the winter, as recommended below, the terminal leaves would not have become so generally infested by *Cercospora* and a higher percentage of foliage would have been retained. The method to follow is therefore evident.

Almond Tree. Treated with Ammoniacal Copper Carbonate. (Pierce.)

ALMOND TREE. UNTREATED. (PIERCE.)

Almond Tree. Treated with Modified Eau Celeste. (Pierce.)

The first treatment should be given the naked trees, before they bloom. This treatment may be either with the modified eau celeste or the ammoniacal copper carbonate. Probably the last is preferable, as its presence is more easily detected, and it is well to be able to see if a sufficient deposit remains on the tree to prevent germination of spores at all times. This is especially necessary during the rainy season. The strength of this spray should be the same as that used in these experiments.

A second and third spray should be given the trees after they are in full leaf. The second shortly after the leaves are well developed and the third about a month later or after the spring rains have ceased. In making these sprays there may be added 10 to 15 per cent more water than was used in the experiments. Observations made on the treated trees lead to the conclusion that this reduction in strength would not detract to a serious extent from the fungicidal qualities of the sprays. It should always be borne in mind, however, that the treatment must be thorough to be effective. In case rains remove the copper salts after the third treatment another spraying should follow.

The cost of treating trees will vary greatly, according to the prices paid for chemicals and labor. Where large quantities of chemicals are purchased the prices should range about as follows:

	Per pound.
Ammonia (26°)	\$0.08
Sal soda	0.02
Copper sulphate, crystals	0.06
Copper carbonate	0.40

At the above prices the ammoniacal copper carbonate required for treating a medium-sized tree three times, in all 6 to 7 gallons, will be close to 5 or 6 cents. The same amounts of the modified eau celéste will cost, at these prices, from 7 to 9 cents. As before stated, when the carbonate of copper can be made at home the cost is reduced, sometimes as low as 18 to 20 cents per pound. With proper facilities, the time required to spray a large almond tree in full leaf, in calm weather, should not exceed eight minutes, and four minutes should do the work on naked trees. This would give twenty minutes for three treatments in the season. Even this is probably allowing more time than would be given in general work.

DESCRIPTION OF PLATES.

PLATE XVIII. Tree No. 18 treated with ammoniacal copper carbonate solution. Amount of foliage retained estimated at 97 per cent. From photograph taken August 3, 1892.

PLATE XIX. Tree No. 16 untreated. Estimated to have retained only 2 per cent of its foliage. From a photograph taken August 3, 1892.

PLATE XX. Tree No. 27 treated with modified eau celeste. Calculated to have retained 97 per cent of its foliage. From a photograph taken August 3, 1892.

EXPERIMENTS IN PREVENTING LEAF DISEASES OF NURSERY STOCK IN WESTERN NEW YORK.

By D. G. FAIRCHILD.

[Plates XXI–XXIX.]

It is the intention to give in the following paper a brief account of experiments made during the seasons of 1891 and 1892 with a view of preventing the various leaf diseases of nursery stock. These experiments were carried on at Geneva, N. Y., one of the largest nursery centers east of the Mississippi. The kindness of Dr. Collier, director of the New York State Agricultural Experiment Station, made it possible for the work to be done upon the station grounds, where proximity to the laboratories and assistance from the station staff greatly facilitated the work.

To bring together in one article the results of the experiments, it will be necessary to repeat in part matter that has previously been published.*

The original object of the experiments conducted at Geneva was to throw light upon the following questions:

(1) Can the leaf-blight of pear, cherry, plum, and quince stocks and the powdery mildew of the apple be prevented by the use of Bordeaux mixture or ammoniacal solution of copper carbonate?

(2) What effect is produced upon the growth of nursery stock, budded and not budded, by repeated treatments with Bordeaux mixture and ammoniacal solution?

(3) What effect, if any, has the variety of stock upon the scion or "bud" with respect to its resistance to leaf-blight?

While the experiments have thrown considerable light upon the first and second questions, the nursery was not extensive enough nor the soil uniform† enough to admit of any but general conclusions being drawn as to the third question. Further, the experiment was begun so late in the season that it was not possible to secure stocks of uniform size, and it is doubtful if any experiments, unless made upon uniform soil, with stocks grown from cuttings, will settle in a satisfactory manner a phase of this problem in which there are so many variable factors.

The various leaf diseases will now be discussed, together with the results of the experiments made for preventing them. The numerous

*Annual Report of the Secretary of Agriculture for 1891, p. 368. Bull. No. 3, Div. of Veg. Pathology, pp. 57–60. Tenth Ann. Report N. Y. Agrl. Expt. Sta., 1892, pp. 179–181.

† As the experiments progressed it was plainly evident that a strip 30 feet or so wide, at the west end of the block, had at some previous time received fertilizers, which rendered it eminently suited to the needs of pear stocks. As no accurate record of this portion of the farm seems to have been kept, it was impossible to ascertain what fertilizers had been used upon the strip.

details, of interest only to those who are pursuing similar studies, are given in small type at the close of the article.

PEAR LEAF-BLIGHT (*Entomosporium maculatum* Lév.).

This disease is perhaps the greatest obstacle to the profitable production of pear stocks. The principal injury is caused by a premature defoliation of the seedlings. When such defoliation takes place early in the season, as is quite commonly the case, the young seedlings are forced to form a new set of leaves, presumably at great expense to the reserve material stored for use the coming spring. Often this formation of new leaves is repeated two or three times, the seedling finally becoming too exhausted to continue the struggle. If the following winter be survived, enough growth may be made to render budding possible.

Although the disease is very abundant on bearing trees further south, it seems to be confined in western New York, at least in its severe attacks, to one, two, and three year old seedlings, occasionally defoliating a budded stock of some susceptible variety like the Flemish Beauty. All ordinary budded stocks are commonly immune from the disease, although the stocks into which the buds are inserted may have been diseased before being budded.* So far as the author's observations go the fungus causing the disease does not attack the seeds of the pear or the cotyledons of the young seedlings until two weeks after the appearance of the latter above the surface of the soil. Early in the season it attacks only the foliage, but later, as the defoliation continues, it is found on the succulent growing tip of the stem. For 3 or 4 inches from the terminal bud the bark is covered with small, sunken spots, bearing in their centers the mature fruiting bodies of the fungus, this condition first becoming noticeable about the middle of August. As first pointed out by Sorauer,† it is in these sunken spots that the parasite passes the winter. In America the parasite lives from year to year, as it does in Germany, upon the bark of the growing seedling and infects the young leaves upon their first appearance in the spring. On May 20, before the foliage of last season's unbudded stocks was two-thirds grown, mature pustules were found upon the young leaves in immediate proximity to these spots upon the twigs. A microscopic examination of the spots revealed the parasite in an active condition. There is little doubt that the infected twigs

* The terms "seedlings" and "stocks" are here employed as in common use among nurserymen. A seedling in nursery parlance means a plant grown from seed before it is transplanted into the nursery row, while the term stock is used to designate the seedling after transplanting either before or after budding. Whenever I have referred to stocks which have been budded I have used the terms "budded stocks" or "buds."

† *Sorauer, P.* Handb. d. Pflanzenkrankheiten. Zweite Aufl., 1886. vol. II, p. 373. Monatschr. d. Ver. zur Beförd. d. Gartenb. Kgl. preuss. St., Jan. 1878. (Cited by Frank, Krankh. d. Pfl., 1880, p. 590.)

are the principal means by which the fungus is carried through the winter and the presence of an ascigerous form, described by Sorauer, seems almost unnecessary to a maintenance of the disease in a region once infested.

The practice of allowing stocks to remain in the nursery rows when leaf-blight has affected them so severely as to render them unbuddable, seems unwise when considered from a hygienic standpoint. Such stocks are almost sure to harbor the parasite in its winter form upon their slender branches, which are lacking in vigor. It is from these stocks that the disease apparently spreads to other plantings of seedlings in the vicinity and to such budded stocks as are susceptible. It would seem advisable, therefore, that when leaf-blight causes a large number of failures in the seed bed, the diseased seedlings should be headed back to within 1 or 2 inches of the ground and all side shoots likely to harbor the parasite removed. Such procedure would undoubtedly decrease the liability to so early an attack of the disease and enable growth to be made before the malady had time to spread from infected localities. The same immunity as that shown by rapidly growing "buds" may prove here a valuable factor. It has been objected, however, that the simultaneous appearance of several shoots from the headed back seedling would prevent, or at least materially hinder the budders in their work the following fall. This obstacle could be overcome by the early removal of all but one shoot. It seems to me that this method of eradicating the disease is sufficiently promising to warrant a thorough test. The matter of protecting seedlings by wind-breaks has not been thoroughly tested to my knowledge, and from observation on the spread of the disease I am inclined to believe it is worthy a systematic trial. The freedom from leaf-blight, which isolated blocks of pear seedlings often show, tends to confirm the observation that the malady travels quite slowly from seedling to seedling. In an experimental block of seedlings mentioned below it required nearly two months for the disease to travel from the east to the west end, a distance of 150 feet.

Two quite distinct experiments were made with a view of preventing this disease, one inaugurated in 1891 to test the effect of fungicides upon stocks, and the other carried on during the season of 1892 with seedlings in the seed bed. The results of only the former experiments are recorded here and an account of the latter is reserved for future publication.

EXPERIMENTS WITH STOCKS.

These experiments were inaugurated in the spring of 1891 and continued until the fall of 1892. The stocks planted in 1891 were sprayed both seasons, the design being to ascertain the effects of two consecutive years. The results are here presented briefly and the minor details are to be found at the close of the article.

All the stocks were sprayed on the same dates; in 1891 on May 21, June 3 and 24, July 9 and 24, and August 8 and 28. One-half the stocks were treated seven times, on the dates just indicated, and one-half only three times, on the first three dates named. In 1892 the dates of treatment were May 26–27, June 15–16, June 23, July 6–7 and 21, and August 5. One-half were sprayed five times, on the first five dates mentioned, the other half six times as just indicated. The only fungicides used were Bordeaux mixture and ammoniacal solution. In 1891 both preparations were of essentially standard strength, but in 1892 the Bordeaux mixture was reduced to the 60-gallon formula, as explained on a subsequent page (p. 262).

FRENCH PEAR STOCKS.

1891.—Four rows (1,922 stocks), of which 1,462 were treated and 460 left untreated. One-half the treated stocks were sprayed with ammoniacal solution, the other half with Bordeaux, at the dates above indicated. Although the disease was not so abundant in 1891 as in 1892, the contrast between treated and untreated was striking. Seven treatments with Bordeaux proved efficacious, while neither three treatments with Bordeaux nor seven with ammoniacal solution showed as good results, and three treatments with ammoniacal solution were without apparent effect. On October 9 a count of those stocks forced by the premature fall of the foliage to put forth new leaves gave the following figures:

TABLE 1.—*Showing number of French stocks forced to put out new leaves.*

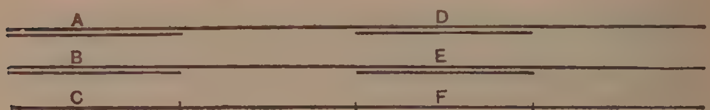
Number and treatment of stocks.	Total re-leaved.	Per cent re-leaved.
388 stocks treated 7 times with Bordeaux	4	1.0
356 stocks treated 3 times with Bordeaux	55	16.4
361 stocks treated 7 times with ammoniacal solution	50	13.8
357 stocks treated 3 times with ammoniacal solution	161	45.0
460 stocks untreated	97	21.0

1892.—The same rows of stocks as were employed in 1891 were treated in 1892, but one-half of them had been budded the fall previous, as subsequently described on pp. 258, 261. The other half was purposely left unbudded to furnish a means of testing the fungicides. The treatments were made on dates given above, using the formulæ mentioned on p. 262. During the course of the season little difference between treated and untreated budded stocks was noticeable, as none but the Flemish Beauty were subject to the disease. At the close of the season, however, the foliage on treated Flemish Beauty was much superior to that on untreated. Bordeaux proved superior to ammoniacal solution and entirely efficacious.

The greatest contrast in the experiment was between the treated and untreated stocks which had not been budded. The susceptibility of these unbudded seedlings afforded an excellent opportunity to test the

efficacy of the fungicides, and the results fully warrant the extended use of Bordeaux mixture upon such stocks. As early as June 24 the difference between treated and untreated sections was visible, 75 per cent of the foliage of the untreated being diseased, while the sections sprayed with Bordeaux mixture remained healthy. Plates XXI and XXII show fairly well the contrast as it appeared on October 11, the two rows standing only 3½ feet apart. The difference consisted not only in the presence of foliage on the treated and its absence on the untreated, but in an increased growth of the former, as is shown by weights and measurements of the stocks given below. A calipering of these stocks in 1891 showed no appreciable average difference in diameter.

DIAGRAM 1.—*Showing arrangement of treated and untreated rows.*



EXPLANATION OF DIAGRAM 1.

A and B, treated 7 times in 1891 and 6 times in 1892 with Bordeaux; C, control on row opposite; D and E, treated three times in 1891 and 5 times in 1892 with Bordeaux; F, control on row opposite. This portion of the experiment was situated on rows VI, VII, and VIII, as indicated in Table 2, below, and in the plan on p. 257. The unbudded portion alone is considered.

TABLE 2.—*Showing weights and measurements of treated and untreated French pear stocks in November.*

Row.	Section.	Diagram designation.	Treatment.	No. of seedlings.	Average weight as dug.	Average weight of top.	Average diameter at collar, in thirty-seconds of an inch.
					Ounces.	*Ounces.*	
VIII	Bb 2	A	Bordeaux, 7 times in 1891, 6 times in 1892	57	7.6	6.4	22.0
VII	Cb 2	B	......do	61	8.8	6.8	27.5
VI	D 6	C	Untreated in 1891 and 1892	57	5.9	4.0	17.6
VIII	Bb 1	D	Bordeaux, 3 times in 1891, 5 times in 1892	63	9.1	7.1	23.1
VII	Cb 1	E	......do	63	7.8	5.7	22.0
VI	Db	F	Untreated in 1891 and 1892	57	5.9	4.0	17.6

The above data were secured in the following manner: The first week in November each individual stock was dug carefully and the dirt cleaned from the roots. It was then calipered and weighed. The top was then cut off and weighed separately. These data are, perhaps, the first published showing the superiority of treated pear seedlings in other respects than that of foliage. As regards a comparison of the two copper compounds, it will be sufficient to say that the Bordeaux was in all respects superior to the ammoniacal solution. In the order of their efficacy the four methods of treatment are as follows: Bordeaux,

6 treatments; Bordeaux, 5 treatments; ammoniacal solution, 6 treatments; ammoniacal solution, 5 treatments. Five treatments with the ammoniacal solution proved almost entirely ineffectual. Plate XXIII shows the average of stocks treated 6 times with ammoniacal solution.

JAPAN PEAR STOCKS.

1891.—One row of 466 stocks was planted in a manner precisely similar to that described for the French stocks. The dates of treatment were as above given, one-half the treated portion receiving three treatments and the other seven, one-half being treated with Bordeaux, the other with ammoniacal solution. The results obtained were striking, as illustrated by the following notes on the *re-leaved* stocks:

TABLE 3.—*Showing number of Japan stocks forced to put out new leaves.*

Number and treatment of stocks.	Total No. re leaved.	Per cent re-leaved.
87 stocks treated 7 times with Bordeaux	1	1.1
88 stocks treated 3 times with Bordeaux	21	23.8
87 stocks treated 7 times with ammoniacal solution	15	17.2
90 stocks treated 3 times with ammoniacal solution	9	10.0
114 stocks untreated	47	41.2

The average diameter of the stocks near the collar was not perceptibly greater in the treated than in the untreated, the average difference amounting to less than one thirty-second of an inch. The untreated Japan stocks suffered more from the disease than the untreated French stocks.

1892.—The same row of stocks as that employed the previous season was treated, but one-half or more of the stocks were budded in 1891, as described subsequently on pp. 259, 261. The treatments given were as described on pp. 262–263. As early as June 24 the unbudded stocks, which had not been treated, showed the disease plainly, every stock being affected. At this date it was evident that the Japan stocks, as introduced from the south, were more susceptible to leaf-blight than the imported French or the native-grown American stocks. The latter were at this date scarcely affected by the disease. From the two years' experiments upon Japan stocks from Franklin Davis & Co.'s nurseries it seems probable that these when imported from the South will not show any greater immunity from leaf-blight than the French or American stocks. A more extended experiment, however, is needed to settle this point. The result of treatments with fungicides was as striking as that gained from the French stocks. The foliage on the budded stocks remained reasonably free from the disease until quite late in September when the stocks in the untreated portions began to drop their leaves badly; those treated 6 times with Bordeaux held their leaves almost intact. The Bordeaux proved in general more efficacious than the ammoniacal solution in the treatment of both budded and unbudded stocks,

and 6 treatments were more effective than 5. But one noteworthy exception existed in the first section treated 5 times with ammoniacal solution, which is possibly explainable by superiority of soil.

Below are given in Table 4 the notes on foliage and caliper made October 19, 1892:

TABLE 4.—*Showing condition of Japan stocks as regards foliage and caliper.*

Section.*	Treatment.	Estimated per cent of foliage dropped.		Average caliper of unbudded at collar in $\frac{1}{32}$ of inch.
		Budded stocks.	Unbudded stocks.	
Aa1	Ammoniacal solution, 5 treatments	0	0	26.6
Ba1	Do	0	80	13.4
Ca1	Do	80	80	15.0
Aa2	Ammonical solution, 6 treatments	0	50	26.3
Ba2	Do	0	15	24.7
Ca2	Do	85	60	21.6
Ab1	Bordeaux mixture 5 treatments	0	10	18.7
Bb1	Do	0	25	19.7
Cb1	Do	40	50	21.3
Ab2	Bordeaux mixture, 6 treatments	0	5	21.5
Bb2	Do	0	10	18.5
Cb2	Do	0	0	23.1
D-I	Untreated (budded)	15		
D-II	Do	40		
D III	Do	95		
D-IV	Untreated (not budded)		98	13.2

* Designations in this column refer to the varieties of "buds," for details of which, see p. 261.

It is noticeable from the above table that Bordeaux mixture afforded the greatest immunity; also that the untreated unbudded stocks made much less growth than those treated with Bordeaux. A reference to the plan (p. 257) will show the situation of the row (No. IX). When it is remembered that of all of the French stocks, those standing in row VIII only 3½ feet distant, made the best growth, the element of soil difference is hardly to be considered as a disturbing factor.

AMERICAN PEAR STOCKS.

1891.—Four rows containing 1,673 stocks were subjected to a course of treatment similar in every respect to that given the French and Japan stocks. Owing to the lateness of the season when application was made to the growers of American seedlings only second-grade stocks were to be obtained. Because of this unfortunate but unavoidable circumstance no comparison could be drawn as to the comparative value of American, Japan, and imported French stocks. The results of the treatments with fungicides while not as striking as with the French stocks, are valuable as adding testimony to the efficacy of the Bordeaux.* Seven treatments with this mixture proved entirely efficacious, raising the percentage of stocks wholly free from the disease from two-tenths of 1 per cent to 39 per cent. On October 9 a count was made of the

* See Bull. No. 3 Div. Veg. Path., p. 59.

number of stocks in each section which pushed out new leaves because of the severity of leaf-blight. The results of this count are as follows:

TABLE 5.—*Showing number of American stocks forced to put out new leaves.*

Number and treatment of stocks.	Total number re-leaved.	Per cent re-leaved.
326 stocks treated 7 times with Bordeaux	7	2.14
288 stocks treated 3 times with Bordeaux	93	32.29
313 stocks treated 7 times with ammoniacal solution	51	16.29
325 stocks treated 3 times with ammoniacal solution	94	28.92
421 stocks untreated	152	36.10

1892.—The same rows of stocks were employed this season as had been treated the previous season, as many as possible of them having been budded as described subsequently on p. 261. Those not budable were left standing for further treatment with fungicides. The treatments were as described on pp. 262–263. Owing to the inferior character of the stocks originally planted this whole block would be considered worthless, as not one-half the stocks were budable in 1891. The effect of the Bordeaux mixture, however, was plainly observable and a rough estimate made October 19 of the percentage of foliage still upon the unbudded stocks shows the Bordeaux to be much superior to the ammoniacal solution, and 6 treatments superior to 5.

QUINCE LEAF-BLIGHT (*Entomosporium maculatum* Lév.).

Much that was said in reference to pear leaf-blight applies equally well to quince leaf-blight, which is caused by the attacks of the same fungus. The parasite, so far as the author's observation goes, never attacks the bark on the young shoots but is confined wholly to the foliage. The Angers quince seems more susceptible than the Orange and it is rare to observe after the first week in September a block of quince cuttings from which at least 50 per cent of the leaves have not fallen. Unlike the disease on the pear, the quince leaf-blight often seriously defoliates bearing trees in this section and commonly causes the fruit-grower much loss from its attacks on the ripening fruits, in which form it is called "fruit spot."*

The experiments in the prevention of this disease were confined to one row of Angers quince cuttings, treated partly with Bordeaux mixture and partly with ammoniacal solution.†

ANGERS QUINCE STOCKS.

1891.—One row of 509 cuttings was planted and treated with fungicides in the manner described on pp. 260–263. The season being an unusually dry one, no disease of any consequence appeared, and as

* Bull. 3 Div. Veg. Path., pp. 65–68, Pl. VII, VIII.

† For formulæ of fungicides and dates of treatment, see pp. 262–263.

stated in a previous publication* the insignificant quantity of leaf-blight present offered no opportunity to test the fungicides in a satisfactory manner.

1892.—The same row of cuttings as employed in 1891 was treated this season, but one-half or more of each section had been budded the fall previous, as noted below, p. 260. The treatments were identical with those made upon the pear stock; see p. 262. As early as July 7 the leaves on the untreated section left without budding showed the disease plainly, while the foliage of those sections treated with Bordeaux and ammoniacal solution remained free from the disease. By August 30 two-thirds of the foliage of the unbudded, untreated portion had fallen to the ground, while the treated sections standing in the same row, as shown in the plan, p. 257, row V, remained intact. Plates XXIV and XXV show the appearance of the treated and untreated sections.

On September 29 the difference manifested by these stocks was not one of foliage only. The twigs of the treated, upon close examination, were apparently a trifle more robust, and the caliper of the cuttings at the base showed a considerable increase not to be attributed to differences in soil. Below are given the data secured from a careful calipering of the *unbudded* stocks at the collar, made October 15. The figures given are in thirty-seconds of an inch and represent the average diameter of stocks in each section:

TABLE 6.—*Showing average caliper of treated and untreated unbudded quince stocks.*

Section.	Number and treatment of stocks.	Average diameter.
Aa1	16 stocks treated 5 times with ammoniacal solution	25.3
Ba1	16 stocks treated 5 times with ammoniacal solution	26.2
Ca1	16 stocks treated 5 times with ammoniacal solution	26.3
Aa2	15 stocks treated 6 times with ammoniacal solution	25.0
Ba2	16 stocks treated 6 times with ammoniacal solution	27.0
Ca2	15 stocks treated 6 times with ammoniacal solution	24.0
Ab1	15 stocks treated 5 times with Bordeaux mixture	27.0
Bb1	16 stocks treated 5 times with Bordeaux mixture	25.2
Cb1	16 stocks treated 5 times with Bordeaux mixture	25.2
Ab2	17 stocks treated 6 times with Bordeaux mixture	29.2
Bb2	17 stocks treated 6 times with Bordeaux mixture	26.4
*Div	90 stocks untreated	20.6

*Unfortunately a section, Cb2, was not staked off in planning the experiment.

The inference from the above table is that the stocks which held their leaves through the season made a greater growth in diameter than those from which the foliage dropped in July and August. Taking the average of all stocks treated with ammoniacal solution, 94 in number, we have 25.7 thirty-seconds of an inch, while the average of 81 stocks treated with Bordeaux was 26.5 thirty-seconds. The better of these two averages (26.5) when compared with the untreated (20.6) gives an increase in diameter of 5.9 thirty-seconds or nearly three-sixteenths of an inch.

* Bull. No. 3, op. cit., pp. 58–59.

CHERRY LEAF-BLIGHT (*Cylindrosporium padi* Karsten).

The leaf-blight of cherries caused by the same species of fungus as that producing plum leaf-blight, is very widespread. Scarcely a wild species of the genus *Prunus* is entirely exempt from the disease, and at all stages from seedlings in the seed bed to old bearing trees, cultivated cherries are subject to its attacks. The greatest variation exists, however, as regards the susceptibility of different varieties, some being nearly exempt and others, as the English Morello, materially damaged by it. Remarkable cases of immunity are sometimes observed. Of seedlings used for budding, only the Mazzard seems in any serious degree damaged by the disease. In unfavorable years the defoliation is so serious as to render the first year's growth of stocks almost insignificant. Mazzard seedlings of the second year are also badly attacked. The greatest damage probably occurs where Mazzard stocks are budded with susceptible varieties, in which case the cumulative effects of the disease appear. It should be noted here, however, that the cherry leaves attacked by the parasite remain attached to the stocks long enough to take on the yellow autumn tints characteristic of foliage from which the valuable ingredients of potash and phosphoric acid have been removed.* It is probable, although no experiments have to my knowledge been made to establish it, that the premature fall of the leaves does not entail so great a loss to the cherry seedling as does the fall of the pear foliage, which drops while still green.

The experiments in the prevention of this disease, extending over a period of two seasons, were made upon the two well-known kinds of stocks, Mahaleb and Mazzard. In 1891 only the stocks not yet budded were treated, while in 1892 the stocks budded in the fall of 1891 were sprayed, suitable control being left.

For record of budding see pp. 258, 260. Bordeaux mixture and ammoniacal solution of standard strength were employed in 1891; ammoniacal solution of standard strength and Bordeaux of one-third strength in 1892.†

MAHALEB CHERRY STOCKS.

1891.—One row of 449 stocks was planted and treated with fungicides at the dates described for all the stocks on p. 263. One-half, excepting controls, received 6 and the other 3 sprayings. One-half were treated with ammoniacal solution, the other with Bordeaux. As mentioned in Bulletin No. 3,‡ where an account of this experiment has already been

*According to the prevailing views of the physiological botanists, Pfeffer, Sachs, Detmer, Wiesner, and others, the valuable mineral constituents of leaves are withdrawn from them at the same time as they become yellow and before they fall to the ground; but the recent paper of Wehmer, *Die dem Laubfall voraufgehende vermeintliche Blattentleerung.* <*Ber. d. deutsch. bot. Gesellsch. 10 Jahrg., Heft. 3, pp. 152–163,* indicates that the grounds for this belief may not have been sufficiently proven, and the whole subject needs further investigation.

† See p. 262 for formulæ of all fungicides used.

‡ Op. cit., p. 58.

given, the leaf-blight was not present in any considerable amount during the season and the efficacy of the two fungicides was not given a test of any severity. The treated portions, however, remained freer from disease than the untreated.

1892.—The same row which had been budded in the fall of 1891 as described subsequently, was treated this season in a manner precisely similar to that described for the pear stocks on page 263. Care was taken that the undersides of the leaves were wet by the spray and to accomplish this the Vermorel nozzle was directed upwards. On June 24 the first signs of leaf-blight were noticed upon the budded, untreated, stocks, the unbudded stocks remaining almost entirely free throughout the season. By July 16 the leaves of the untreated began to fall and continued dropping until many of the stocks were left nearly leafless. On October 4 a careful count was made of the number of leaves which had fallen from each individual stock in the row. This was accomplished, in a comparative way, by counting the leaf-scars on each stock. Below is given for convenience a condensed statement of the condition of the stocks with regard to height, diameter 3 inches above the union, and freedom from leaf-blight. All numbers represent averages. Height above ground (measured September 28) is represented in feet and inches, while the figures for diameter (measured October 15) are in thirty-seconds of an inch. Only budded stocks are here taken into account.

TABLE 7.—*Showing condition of budded Mahaleb stocks, treated and untreated, as regards foliage and measurements.*

Section.	Numbers, kinds, and treatment of stocks.	Average number of leaves fallen October 4.	Average height above ground.		Average caliper 3 inches above union.
			Feet.	*Inches.*	
Aa 1	16 budded Windsor stocks. Ammoniacal, 5 treatments	8.0	5	8	23
Aa 2	18 budded Windsor stocks. Ammoniacal, 6 treatments	7.8	5	10	23
Ab 1	13 budded Windsor stocks. Bordeaux, 5 treatments	13.1	6	0	24
Ab 2	17 budded Windsor stocks. Bordeaux, 6 treatments	7.4	6	0	25
D-III	7 budded Windsor stocks. Untreated	**54.8**	5	0	16
Ba 1	18 budded Yellow Spanish stocks. Ammoniacal, 5 treatments	6.4	4	9	22
Ba 2	17 budded Yellow Spanish stocks. Ammoniacal, 6 treatments	6.4	4	9	21
Bb 1	18 budded Yellow Spanish stocks. Bordeaux, 5 treatments	7.3	5	4	21
Bb 2	18 budded Yellow Spanish stocks, Bordeaux, 6 treatments	4.8	5	1	23
D-II	8 budded Yellow Spanish stocks. Untreated	**21.3**	4	1	16
Ca 1	16 budded Montmorency stocks. Ammoniacal, 5 treatments	8.5	3	7	21
Ca 2	18 budded Montmorency stocks. Ammoniacal, 6 treatments	10.3	3	5	21
Cb 1	22 budded Montmorency stocks. Bordeaux, 5 treatments	4.0	3	5	21
Cb 2	16 budded Montmorency stocks. Bordeaux, 6 treatments	6.1	3	9	19
D-I	4 budded Montmorency stocks. Untreated	**65.7**	3	6	17

The conclusion which can be drawn from the table seems to be that the treated sections held their leaves better, made as good a growth in height, and without exception a greater growth in diameter, or "caliper," than the untreated sections. That this increased growth was due entirely to the fungicide it will not be possible to maintain, for this difference may possibly have been brought about in part or wholly by variations in the soil. That none of the mixtures injured the "buds" it is believed is clearly shown.

The answer to question 3, as to the effect of fungicides on the growth of budded stocks is here, for the Bordeaux mixture at least, satisfactorily found, for both Windsor and Yellow Spanish stocks did better under treatment with Bordeaux than without treatment. There still remains a doubt as to the beneficial effect of ammoniacal solution. In all cases where used it was apparently slightly injurious to the foliage. The leaves assumed a yellowish unhealthy appearance. Plates XXVI and XXVII show the comparison between treated and untreated "buds."

MAZZARD CHERRY STOCKS.

1891.—One row of 468 stocks was experimented with, receiving as nearly as possible a course of treatment identical with that given the Mahaleb stocks. During the season, as in the case of the Mahalebs, only an insignificant amount of leaf-blight was present. affording no opportunity to test the fungicides. The powdery mildew (*Podosphæra oxyacanthæ* (DC.) Winter ?) made its appearance in small amount on the stocks in August and offered an opportunity to observe the beneficial effects of Bordeaux mixture in the treatment of this disease. Seven treatments with Bordeaux materially decreased the amount of the disease and proved superior to seven treatments with ammoniacal solution.* Three early treatments with either fungicide had no preventive effect.

1892.—The same row as that treated in 1891 was used this season, but budded with three different varieties identical with those budded on the Mahaleb stocks as shown in the table on p. 260. The treatments were similar in all respects to those given the Mahaleb stocks. The condition of the stocks at the close of the season is shown by the following table:

*See Bull. No. 3 Div. Veg. Path., 1892, p. 58.

TABLE 8.—*Showing condition of budded Mazzard stocks treated and untreated as regards foliage and measurements.*

Section.	Number, kinds, and treatment of stocks.	Average number of leaves fallen Oct. 10.	Average height above ground.		Average caliper 3 inches above union.
			Feet.	*Inches.*	
Aa 1	25 budded Windsor stocks; ammoniacal, 5 treatments	5.0	4	10	16
Aa 2	30 budded Windsor stocks; ammoniacal, 6 treatments	5.3	5	6	20
Ab 1	27 budded Windsor stocks; Bordeaux, 5 treatments	6.4	5	9	20
Ab 2	27 budded Windsor stocks; Bordeaux, 6 treatments	5.3	5	10	20
D-I*	11 budded Windsor stocks; untreated	13.7	4	9	20
Ba 1	27 budded Yellow Spanish stocks; ammoniacal, 5 treatments	4.2	4	5	19
Ba 2	28 budded Yellow Spanish stocks; ammoniacal, 6 treatments	4.6	4	10	21
Bb 1	31 budded Yellow Spanish stocks; Bordeaux, 5 treatments	2.9	5	6	18
Bb 2	31 budded Yellow Spanish stocks; Bordeaux, 6 treatments	2.5	4	5	18
D-II	14 budded Yellow Spanish stocks; untreated	8.7	3	2	15
Ca 1	26 budded Montmorency stocks; ammoniacal, 5 treatments	6.3	3	7	18
Ca 2	18 budded Montmorency stocks; ammoniacal, 6 treatments	6.8	3	3	17
Cb 1	26 budded Montmorency stocks; Bordeaux, 5 treatments	5.9	3	1	17
Cb 2	26 budded Montmorency stocks; Bordeaux, 6 treatments	5.0	3	1	17
D-III	7 budded Montmorency stocks; untreated	24.2	2	8	14

* By an accident this section received one late spraying with Bordeaux and hence it is rendered unfit for comparison.

The disease did comparatively little damage upon these stocks, but as shown by the table, the treated sections were superior to the untreated, and the Bordeaux slightly superior to the ammoniacal solution when 6 treatments are compared.* The difference between 5 and 6 treatments was not very marked.

A comparison of the two tables brings out the fact which is noteworthy in this connection, that the "buds"† on Mahaleb stocks averaged greater in diameter throughout than those on the Mazzard. This difference is constant when stocks receiving the same treatment are compared in each row, with the exception of the untreated section of Windsors when compared with that treated once by mistake. This constant difference in diameter, at 3 inches above the base ("caliper"), is of such importance as to merit further observations. The author regrets that the control rows were left so small, and feels warranted in drawing only the general conclusion, which was strikingly demonstrated that the fungicides were effective to a remarkable degree in preventing the disease and that treated stocks made the best growth.

*The superiority of Bordeaux is not fully shown by the figures, as in every case the effect of the ammoniacal solution was evidently injurious to the health of the foliage.

†The term "bud" is here used, as among nurserymen, to indicate a budded stock after the top has been cut off and the inserted bud itself allowed to grow.

PLUM LEAF-BLIGHT (*Cylindrosporium padi* Karsten.)

The plum leaf-blight in western New York, aside from giving much trouble to nurserymen, does very great damage to many varieties of bearing trees, defoliating them in August and September. This disease is considered by the plum-growers in the vicinity of Geneva as their most persistent enemy. A large orchard belonging to E. Smith & Sons, 2 miles northwest of the city, was, they informed me, winter-killed about thirty years ago because of defoliation the summer previous. It is a common opinion among orchardists that leaf-blight, through its retarding effect upon the maturation of the wood, renders the trees incapable of withstanding the changes in temperature of a trying winter. Whatever the explanation of this fact may be, it seems self-evident that a tree which drops its leaves before the normal season suffers very material loss.

Of nursery stocks, the native-grown seedlings suffer the most from this disease, often losing all their leaves by the middle of August. Myrobolan and Marianna stocks are not to any extent subject the first season. In entire contradistinction to the immunity exhibited by pear "buds" which resist to a remarkable degree pear leaf-blight, the budded plum stocks are particularly susceptible to plum leaf-blight. Apparently the same conditions of rapid growth which afford immunity in the one case tend to susceptibility in the other. The two instances offer a fertile field for inquiry.

The experiments on this disease were made with Bordeaux mixture and ammoniacal solution upon two rows of stocks, one of Marianna, containing 504 stocks, and the other of Myrobolan, containing 474 stocks. As described previously* the results of the first season's experiment were entirely negative, as the disease failed to appear.

On October 9 the three varieties, Early Prolific (Early Rivers), Purple Egg (Hudson River Purple Egg), and Italian Prune (Fellenburg), were budded upon both rows of stocks as set forth subsequently, p. 258. Numerous stocks were left unbudded to test the effect of the fungicides and the end of each row was left untreated.

The rows were treated in 1892 with Bordeaux and ammoniacal solution, the formulæ of which are described on p. 262. One-half the treated stocks received 5 sprayings and the other 6, at the dates given on p. 243. In all respects the two rows were treated alike.

MYROBOLAN STOCKS.

1892.—The disease made its first appearance in June upon the unbudded stocks which were carried over from 1891, and strangely enough only upon the treated portions. This dropping of the treated Myrobolan foliage was confined to the leaves situated on the larger

* Bull. No. 3 Div. Veg. Path., p. 58.

limbs in the interior portion of the bushy growth. Although only a small per cent of the foliage was thus affected, the difference between treated and untreated was quite evident. After the lapse of three or four weeks this falling of the leaves ceased. The unbudded stocks which were not treated remained remarkably free from the disease, but in this respect were excelled by the Marianna unbudded, untreated stocks. The budded stocks were not so soon affected as the unbudded, but the Early Prolific "buds" in the untreated section began dropping their foliage in July and throughout the season were manifestly worse affected. The following table shows the data collected in September and October, after all growth had practically ceased:

TABLE 9.—*Showing condition of budded Myrobolan stocks treated and untreated, as regards foliage and measurements.*

Section.	Number, kinds, and treatment of stocks.	Average number of leaves fallen October 10.	Average height above ground September 28.		Average caliper 3 inches above union, October 15.
			Feet.	*Inches.*	
Aa1	11 budded Early Prolific stocks, ammoniacal, 5 treatments	69.8	3	6	14.8
Aa2	16 budded Early Prolific stocks, ammoniacal, 6 treatments	115.8	3	6	14.3
Ab1	18 budded Early Prolific stocks, Bordeaux, 5 treatments	66.0	4	0	15.4
Ab2	13 budded Early Prolific stocks, Bordeaux, 6 treatments	57.5	3	8	16.9
D-I	8 budded Early Prolific stocks, untreated	**312.5**	3	9	14.3
Ba1	13 budded Purple Egg stocks, ammoniacal, 5 treatments	36.3	4	1	16.2
Ba2	20 budded Purple Egg stocks, ammoniacal, 6 treatments	32.8	4	2	15.1
Bb1	16 budded Purple Egg stocks, Bordeaux, 5 treatments	6.1	3	8	15.4
Bb2	16 budded Purple Egg stocks, Bordeaux, 6 treatments	9.7	4	3	15.6
D-II	10 budded Purple Egg stocks, untreated	**123.3**	4	7	16.4
Ca1	12 budded Italian Prune stocks, ammoniacal, 5 treatments	15.8	3	10	14.3
Ca2	16 budded Italian Prune stocks, ammoniacal, 6 treatments	8.2	3	7	15.3
Cb1	16 budded Italian Prune stocks, Bordeaux, 5 treatments	7.8	3	6	15.5
Cb2	15 budded Italian Prune stocks, Bordeaux, 6 treatments	6.3	4	0	16.4
D-III	11 budded Italian Prune stocks, untreated	**52.8**	3	9	15.0

From this table the only conclusion admissible is in regard to the amount of leaf-blight. It is evident that the treated portions lost only a small number of leaves in comparison with the untreated, and in so far the fungicides proved effective.

MARIANNA STOCKS.

1892.—The treatment of these stocks was in all respects identical with that of the Myrobolan stocks and the results were in general similar. The *treated unbudded* stocks lost a number of their leaves from an early attack of the fungus in June and July, but the *untreated unbudded* portion of the row remained remarkably free from the disease throughout the season, more so in this regard than the Myrobolan. The

budded stocks showed little superiority in regard to leaf-blight over the budded Myrobolan and evidently no considerable degree of immunity was afforded by the stock to the scion. But a comparison of the two tables brings out the fact that the Purple Egg "buds" made markedly the best growth upon Marianna stocks. These "buds" averaged more than one-eighth of an inch greater in diameter and were on an average 10 inches higher. The other less rapidly growing stocks did not show such a marked difference, and too much reliance ought not to be placed on data gathered from so small a number of stocks. Certain it is, however, that the Marianna proved superior in this single experiment.

TABLE 10.—*Showing condition of budded Marianna stocks, treated and untreated, as regards foliage and measurements.*

Section.	Number, kinds, and treatment of stocks.	Average number of leaves fallen October 11.	Average height above ground September 28.		Average caliber 3 inches above union, October 15.
			Feet.	*Inches.*	*Inches.*
Aa1	9 budded Early Prolific stocks, ammoniacal, 5 treatments	98.8	3	3	15.5
Aa2	14 budded Early Prolific stocks, ammoniacal, 6 treatments	63.3	3	6	16.3
Ab1	14 budded Early Prolific stocks, Bordeaux, 5 treatments	99.6	4	4	20.2
Ab2	5 budded Early Prolific stocks, Bordeaux, 6 treatments	71.6	3	2	18.5
D-I	10 budded Early Prolific stocks, untreated	311.2	3	7	15.9
Ba1	17 budded Purple Egg stocks, ammoniacal, 5 treatments	39.1	5	5	21.2
Ba2	23 budded Purple Egg stocks, ammoniacal, 6 treatments	45.1	4	7	20.6
Bb1	17 budded Purple Egg stocks, Bordeaux, 5 treatments	42.7	5	0	21.3
Bb2	21 budded Purple Egg stocks, Bordeaux, 6 treatments	26.9	5	1	20.2
D-II	14 budded Purple Egg stocks, untreated	143.2	5	0	20.5
D-III*	12 budded Purple Egg stocks, untreated	177.2	4	11	19.2
Ca1	19 budded Italian Prune stocks, ammoniacal, 5 treatments	16.8	3	6	17.2
Ca2	24 budded Italian Prune stocks, ammoniacal, 6 treatments	17.5	4	0	14.5
Cb1	20 budded Italian Prune stocks, Bordeaux, 5 treatments	11	4	7	20
Cb2	19 budded Italian Prune stocks, Bordeaux, 6 treatments	12.2	4	2	19

* By another mistake in budding, those stocks which should have received Italian Prune buds were budded with Purple Egg buds.

As regards the effects of the treatments, the only fairly deducible conclusion is that the Bordeaux mixture and ammoniacal solution prevented the disease to a notable degree, sufficient, it is believed, to warrant further extended trial in nursery practice. Although not evident from the table, the ammoniacal solution is in reality inferior to Bordeaux, as it injures the foliage of the treated "buds." On this account it can not be recommended for the treatment of plum stocks. Plates XXVIII and XXIX show the treated and untreated "buds" as they appeared in the experiments.

APPLE POWDERY MILDEW (*Podosphæra oxyacanthæ* (DC) Winter?).

Seedling apples sometimes suffer quite severely from this disease, which attacks their young shoot tips, often stunting the growth of the seedlings and preventing them from attaining a suitable size the first season. Compared with the injury caused by the apple thrips, however, that brought about by mildew is surely insignificant and, in New York State at least, hardly warrants any expensive measures for its prevention. The disease usually appears late in September, when the principal growth has been made, and seldom, if ever, spreads to vigorously growing budded stocks, even when these are in close proximity to diseased seedlings. The malady was not observed on bearing trees in the neighborhood of Geneva.

The experiments for the prevention of this disease comprised in 1891 about 1,000 American stocks and the same number of French stocks, besides 500 seedlings. As stated in a previous publication,* the results of the first season's treatment of the stocks was entirely negative and the treatments of seedlings which were made on May 21, June 3, 24, July 9, 24, and August 8, as well as the early treatments made on the first three dates mentioned, failed entirely to prevent the appearance of mildew the first week in September. Bordeaux mixture and ammoniacal solution alone were used, the formulæ being those described on p. 262. This failure of the fungicides is considered by the author merely as additional testimony to the fact observed that the mixtures were largely washed off before the disease appeared. On August 7 the French and American stocks were budded with Twenty Ounce, Fameuse and Early Strawberry buds, as described in detail on p. 259, and in the season of 1892 the budded, and such of the stocks as were left unbudded were treated with Bordeaux mixture and ammoniacal solution at dates the same as for all other stocks, viz, May 27; June 16, 23; July 7, 21; and August 5. One-half the treated stocks were sprayed 5 times on the first five dates mentioned, the other half were sprayed 6 times.

No powdery mildew appeared during the course of the season, and in October the results of the treatments were entirely negative. The apple thrips, however, attacked the budded and unbudded stocks and injured them severely. The mixtures had, as might be expected, no effect upon these insects.

DETAILS OF THE EXPERIMENTS.

The following pages comprise the details of the experiments, which are removed from the general account in order to render the latter more comprehensible. They will prove of interest only to specialists on the subject.

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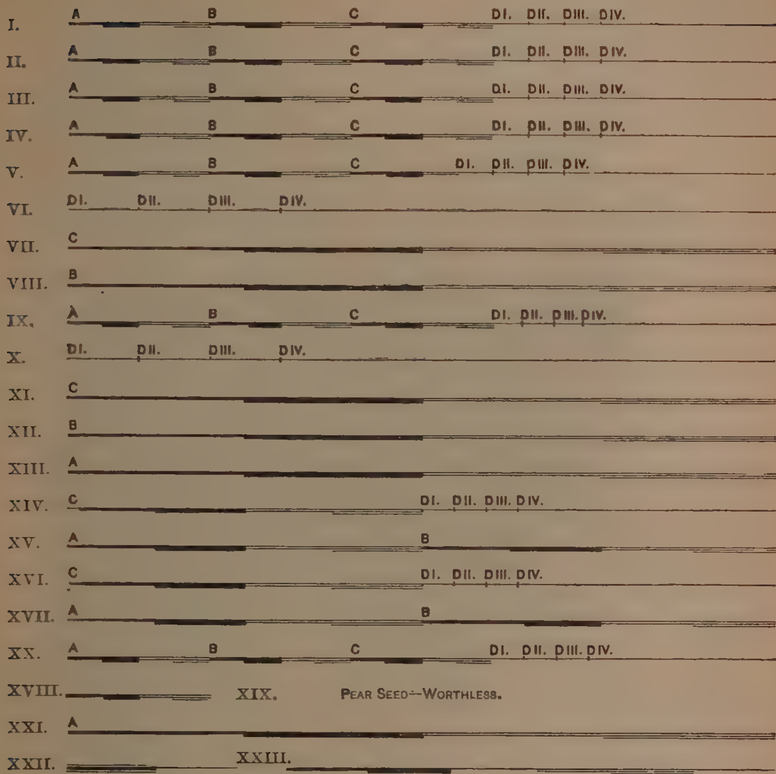
*Bull. No. 3, loc. cit., p. 60.

DIAGRAM 2.—*Plan of nursery experiment at Geneva, N. Y.*



Treated 3 to 5 times with ammoniacal solution, (a 1).
Treated 6 to 7 times with ammoniacal solution, (a 2).
Treated 4 times with mixture No. 13.
Untreated.
Treated 3 to 5 times with Bordeaux, (b 1).
Treated 6 to 7 times with Bordeaux, (b 2).

The actual proportions of the experimental field do not admit of any but a diagrammatic representation. The location of the field is designated in the records of the station as "main farm plat B." The rows ran east and west, the west end of each row being indicated by a Roman numeral. These numerals are for convenience of reference (see account following). The capital letters heading the sections of each row refer to the budding. For example: Row I, Section A, was budded with Windsor; Row I, Section B, with Yellow Spanish, precisely as set forth below. The treatments with fungicides which each section and subsection received are indicated by the key below Diagram 2.

The sections of the various rows were budded as below described.

Row I. Mahaleb cherry stocks budded August 5, 1891.

Section A with Windsor.
B with Yellow Spanish.
C with Montmorency.
DI with Montmorency.
DII with Yellow Spanish.
DIII with Windsor.
DIV unbudded.

Row II. Mazzard cherry stocks budded August 5, 1891.

Section A with Windsor.
B with Yellow Spanish.
C with Montmorency.
DI with Windsor.
DII with Yellow Spanish.
DIII with Montmorency.
DIV unbudded.

Row III. Myrobolan plum stocks budded September 10, 1891.

Section A with Early Prolific.
B with Purple Egg.
C with Italian Prune.
DI with Early Prolific.
DII with Purple Egg.
DIII with Italian Prune.
DIV unbudded.

Row IV. Marianna plum stocks budded September 10, 1891.

Section A with Early Prolific.
B with Purple Egg.
C with Italian Prune.
DI with Early Prolific.
DII with Purple Egg.*
DIII with Purple Egg.†
DIV unbudded.

Row V. Angers quince stocks budded August 6, 1891.

Section A with Duchess.
B with Anjou.
C with Flemish Beauty.
DI with Duchess.
DII with Anjou.
DIII with Anjou.
DIV unbudded.

Row VI. French pear stocks budded August 7, 1891.

Section DI with Duchess.
DII with Anjou.
DIII with Flemish Beauty.
DIV unbudded.

Row VII. French pear stocks budded August 7, 1891.

Section C with Flemish Beauty.

Row VIII. French pear stocks budded August 7, 1891.

Section B with Anjou.

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* A variety of recent introduction originated on the Hudson River.

† The budder's blunder in inserting these in place of Italian Prune.

Row IX. Japan pear stocks budded August 5, 1891.
Section A with Duchess.
B with Anjou.
C with Flemish Beauty.
DI with Duchess.
DII with Anjou.
DIII with Flemish Beauty.
DIV unbudded.

Row X. American pear stocks budded August 7, 1891.
Section DI with Duchess.
DII with Anjou.
DIII with Flemish Beauty.
DIV unbudded.

Row XI. American pear stocks budded August 7, 1891.
Section C with Flemish Beauty.

Row XII. American pear stocks budded August 7, 1891.
Section B with Anjou.

Row XIII. American pear stocks budded August 7, 1891.
Section A with Duchess.

Row XIV. American apple stocks budded August 7, 1891.
Section C with Twenty Ounce.
DI with Fameuse.
DII with Early Strawberry.
DIII with Twenty Ounce.
DIV unbudded.

Row XV. American apple stocks budded August 7, 1891.
Section A with Fameuse.
B with Early Strawberry.

Row XVI. French apple stocks budded August 7, 1891.
Section C with Twenty Ounce.
DI with Fameuse.
DII with Early Strawberry.
DIII with Twenty Ounce.
DIV unbudded.

Row XVII. French apple stocks budded August 7, 1891.
Section A with Fameuse.
B with Early Strawberry.

Row XVIII. French apple seeds.
Row XIX. French pear seeds which did not germinate.
Row XX. Peach seedlings which remained healthy.
Row XXI. French pear stocks budded August 7, 1891.
Section A with Duchess.

Row XXII. Plum seedlings of *Prunus domestica.**
Row XXIII. Horse chestnut seedlings.*

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*The results of treatments of plum and horse chestnut seedlings are reserved for future publication.

TABLE 11.—*Showing the number of budded stocks in each treated and untreated section.*

[The small letter *a* indicates that the stocks were treated with ammonical solution, the letter *b* that they were sprayed with Bordeaux. The Arabic numeral 1 indicates that the stocks were treated 5 times, the number 2 that they were treated 6 times. The sections marked I–IV were not treated.]

Row.	Kind of stock.	Section.	Variety of bud.	Number budded.	Number left unbudded.
I	Mahaleb	Aa1	Windsor	17	3
		Aa2	do	18	4
		Ab1	do	*13	2
		Ab2	do	20	0
		Ba1	Yellow Spanish	21	2
		Ba2	do	22	1
		Bb1	do	22	0
		Bb2	do	20	2
		Ca1	Montmorency	18	2
		Ca2	do	20	2
		Cb1	do	23	0
		Cb2	do	18	2
		DI	do	11	1
		DII	Yellow Spanish	11	0
		DIII	Windsor	8	0
		DIV	Not budded		40
II	Mazzard	Aa1	Windsor	28	0
		Aa2	do	30	0
		Ab1	do	27	0
		Ab2	do	25	0
		Ba1	Yellow Spanish	29	1
		Ba2	do	29	0
		Bb1	do	31	0
		Bb2	do	31	1
		Ca1	Montmorency	27	1
		Ca2	do	23	4
		Cb1	do	29	1
		Cb2	do	29	0
		DI	Windsor	14	1
		DII	Yellow Spanish	15	0
		DIII	Montmorency	15	0
		DIV	Not budded		62
III	Myrobolan	Aa1	Early Prolific	14	11
		Aa2	do	20	9
		Ab1	do	21	5
		Ab2	do	19	4
		Ba1	Purple Egg	17	8
		Ba2	do	24	6
		Bb1	do	18	8
		Bb2	do	16	7
		Ca1	Italian Prune	13	12
		Ca2	do	17	11
		Cb1	do	18	7
		Cb2	do	18	7
		DI	Early Prolific	13	0
		DII	Purple Egg	13	2
		DIII	Italian Prune	14	1
		DIV	Not budded		71
IV	Marianna	Aa1	Early Prolific	17	6
		Aa2	do	22	6
		Ab1	do	20	5
		Ab2	do	15	7
		Ba1	Purple Egg	19	6
		Ba2	do	27	0
		Bb1	do	17	6
		Bb2	do	22	5
		Ca1	Italian Prune	22	5
		Ca2	do	25	5
		Cb1	do	24	5
		Cb2	do	23	5
		DI	Early Prolific	13	1
		DII	Purple Egg	14	0
		DIII	Purple Egg †	14	0
		DIV	Not budded		80
V	Angers quince	Aa1	Duchess	15	16
		Aa2	do	15	15
		Ab1	do	15	15
		Ab2	do	15	17
		Ba1	Anjou	15	15
		Ba2	do	14	16
		Bb1	do	14	15
		Bb2	do	15	17
		Ca1	Flemish Beauty	15	16

* Five buds of the Montmorency were inserted by mistake of the budder.
† Should have been Fellenburg—mistake of budder.

TABLE 11.—*Showing the number of budded stocks in each treated and untreated section*—Continued.

Row.	Kind of stock.	Section.	Variety of bud.	Number budded.	Number left unbudded.
V	Angers quince	Ca2	Flemish Beauty	15	14
		Cb1	......do	15	16
		Cb2	......do	15	0
		DI	Duchess	15	0
		DII	Anjou	14	1
		DIII	......do*	15	0
		DIV	Not budded		97
VI	French pear	DI	Duchess	58	3
		DII	Anjou	59	2
		DIII	Flemish Beauty	58	2
		DIV	Not budded		251
VII	French pear	Ca1	Flemish Beauty	59	51
		Ca2	......do	64	59
		Cb1	......do	59	55
		Cb2	......do	62	69
VIII	French pear	Ba1	Anjou	63	62
		Ba2	......do	61	63
		Bb1	......do	59	63
		Bb2	......do	61	60
IX	Japan pear	Aa1	Duchess	15	9
		Aa2	......do	11	11
		Ab1	......do	14	13
		Ab2	......do	12	8
		Ba1	Anjou	14	7
		Ba2	......do	12	12
		Bb1	......do	13	9
		Bb2	......do	14	9
		Ca1	Flemish Beauty	16	8
		Ca2	......do	17	11
		Cb1	......do	13	13
		Cb2	......do	12	13
		DI	Duchess	11	0
		DII	Anjou	13	0
		DIII	Flemish Beauty	14	0
		DIV	Not budded		62
X	American pear	DI	Duchess	29	3
		DII	Anjou	28	5
		DIII	Flemish Beauty	33	2
		DIV	Not budded		202
XI	American pear	Ca1	Flemish Beauty	71	10
		Ca2	......do	58	11
		Cb1	......do	57	10
		Cb2	......do	70	11
XII	American pear	Ba1	Anjou	56	13
		Ba2	......do	58	8
		Bb1	......do	49	10
		Bb2	......do	63	17
XIII	American pear	Aa1	Duchess	64	21
		Aa2	......do	38	33
		Ab1	......do	39	16
		Ab2	......do	47	14
XIV	American apple †				
XV	American apple †				
XVI	French apple †				
XVII	French apple †				
XVIII	French apple seedlings †				
XIX	French pear seed †				
XX	Peach seedlings †				
XXI	French pear	Aa1	Duchess	53	39
		Aa2	......do	46	37
		Ab1	......do	31	48
		Ab2	......do	27	57

* Should have been Flemish Beauty—mistake of budder.
† As no disease appeared in the apple buds data is not valuable. Apple seedlings were not budded; peach showed no disease; none of pear seed germinated.

Soil, stocks, and buds.—The soil upon which the nursery was planted is considered by practical nurserymen as well suited to the growing of plums and cherries but as lacking somewhat in the qualities which go to make up the best soil for pears and apples, being of insufficient depth and a trifle too light. Immediately previous to the experiment the soil had been planted to corn, but what fertilizers had been used, if any, and what crops were grown anterior to that season, I have not been able to ascertain. No fertilizer was applied before putting in the stocks and the

only treatment the soil received was a dressing in November and December of 1891, of 33 wagon loads of well-rotted barnyard manure from the station manure platform, evenly distributed between the rows.

The stocks were furnished by various nursery firms as stated in a previous article,* and the different lots were of apparently equal vigor—first grade with the exception of American pear stocks, which owing to the lateness of the season were third grade. In the planting which was done between the dates of April 27 and May 3, care was taken that each stock was firmly pressed into the soil. Stocks of the same kind from different nursery firms were thoroughly mixed together. In all respects the normal nursery methods were followed out as nearly as possible. The budding was done on the dates above recorded by two experienced budders employed by the Station. The scions for cherry, pear, and apple buds were cut from trees growing in the nursery rows† of Selover and Atwood. Plum scions were furnished by Maxwell & Bros., from their bearing orchard.

Treatment with fungicides.—Only the two well-known fungicides, ammoniacal solution of copper carbonate and Bordeaux mixture were used. The formulæ used in 1891 were those in common use throughout America. The Bordeaux mixture was diluted in the treatments for 1892 and prepared after the manner first proposed by Dr. G. Patrigeon.‡

The formulæ are given below:

Ammoniacal solution of copper carbonate, formula used in 1891.

Five ounces of cupric basic carbonate (copper carbonate) dissolved in ammonia (3 to 4 pints of 26) and added to 50 gallons of water. Care was taken that all the carbonate was dissolved in the ammonia, enough being added for the solution.

Ammoniacal solution of copper carbonate, formula used in 1892.

Identical with the above in strength. The carbonate was wetted with one pint of water, previous to adding the ammonia, to facilitate the solution.

Bordeaux mixture, formula used in 1891.

Six pounds of cupric sulphate (copper sulphate or bluestone) dissolved in 12 gallons of water. Four pounds of stone lime slaked in a small quantity of water and made up to 3 or 4 gallons of thin milk. The lime was added slowly to the cupric sulphate and the whole made up to 22 gallons.

Bordeaux mixture, formula used in 1892.

Two pounds cupric sulphate dissolved in 15 gallons of water. Two pounds Rhode Island stone lime slaked in small quantity of water and made up to 5 gallons. The lime was added slowly to the cupric sulphate, testing the mixture frequently during the addition with a few drops of a concentrated solution of potassium ferrocyanide (yellow prussiate of potash) and ceasing the addition of the lime when no red color was given to the drops of the ferrocyanide. For convenience this may be called a 60-gallon formula, as it requires that amount of water to contain as much copper sulphate as the standard strength, viz, 6 pounds.

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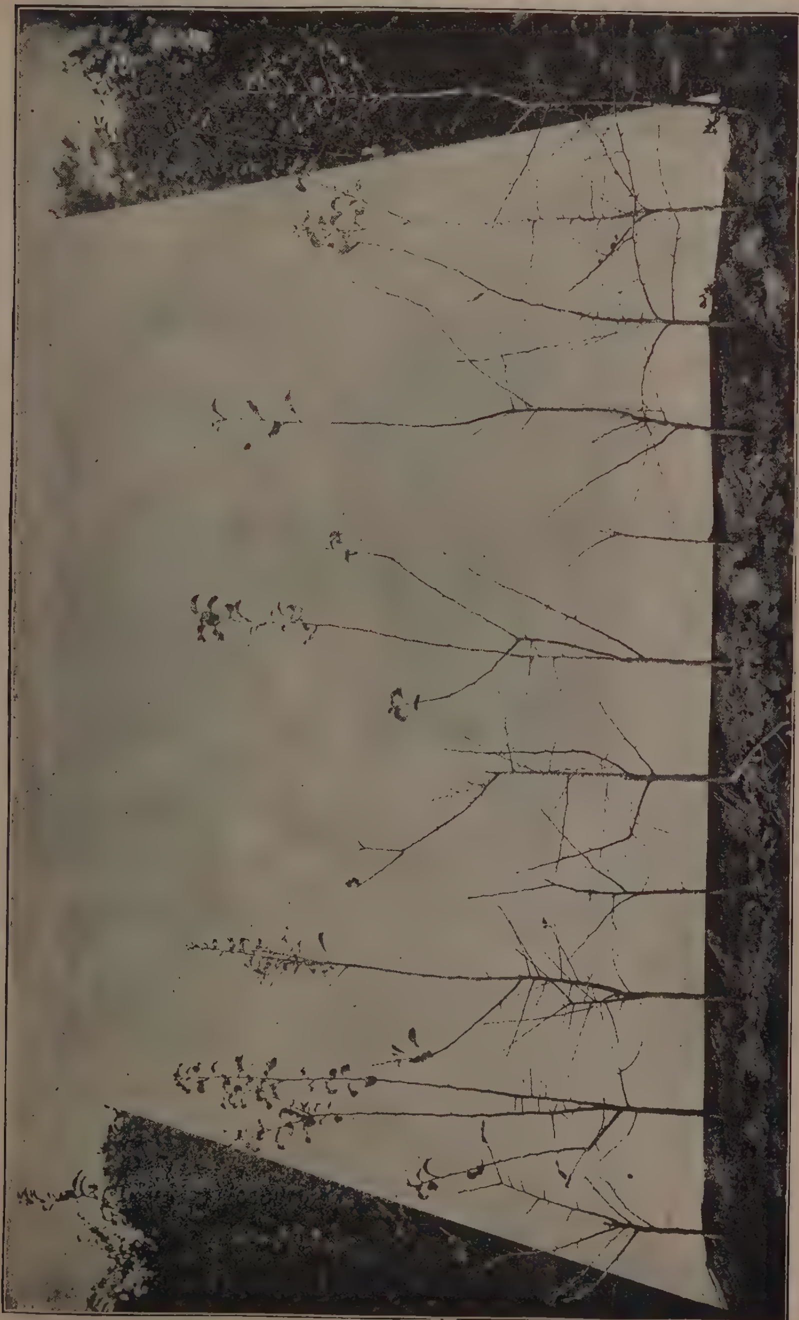
* Bull No. 3, Div. Veg. Path., p. 57.

† A practice much in vogue among nurserymen, but certainly not founded upon a knowledge of the laws governing bud variation. The selection of buds from individual bearing trees of known vigor and productiveness is insisted upon by the best cultivators.

‡ Patrigeon, G. *Revue Viticole*, < Jour. d' Agric. Pratique, 1890, t. I. 54e année, p. 701.

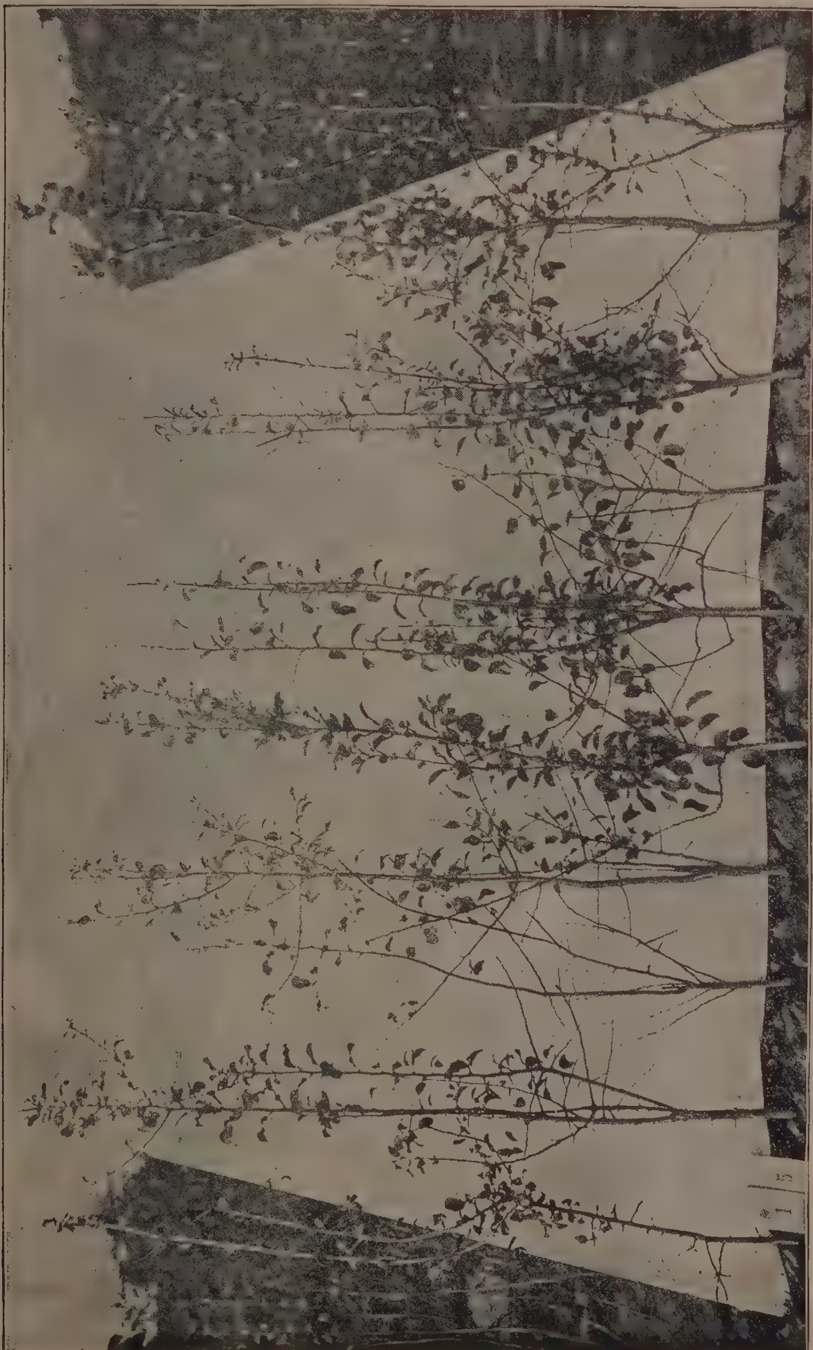
PEAR LEAF-BLIGHT.

French pear stocks. Treated with Bordeaux mixture. (Fairchild.)



PEAR LEAF-BLIGHT.

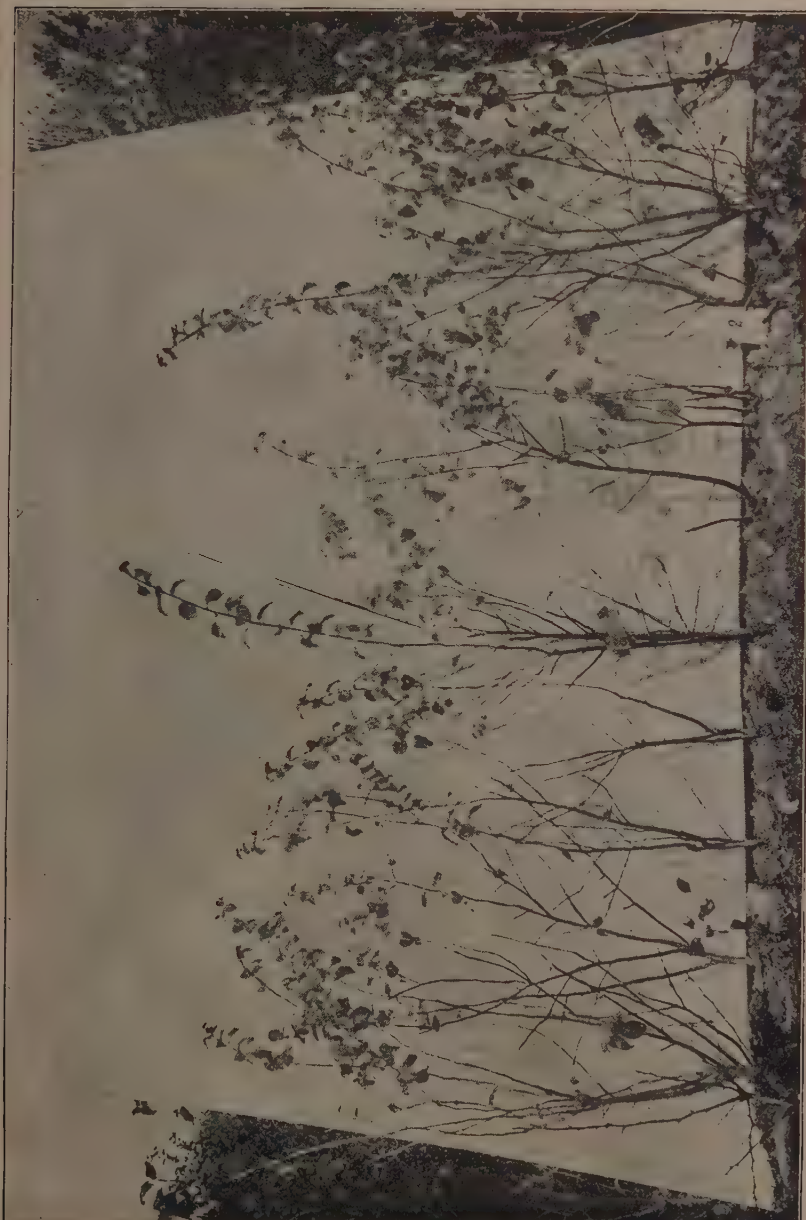
French pear stocks. Untreated. (Fairchild.)



Pear Leaf-blight.

French pear stocks. Treated with ammoniacal solution. (Fairchild.)

QUINCE LEAF-BLIGHT.
Angers quince stocks. Treated with Bordeaux mixture. (Fairchild.)



QUINCE LEAF-BLIGHT.
Angers quince stocks. Untreated. (Fairchild.)

Cherry Leaf-blight.

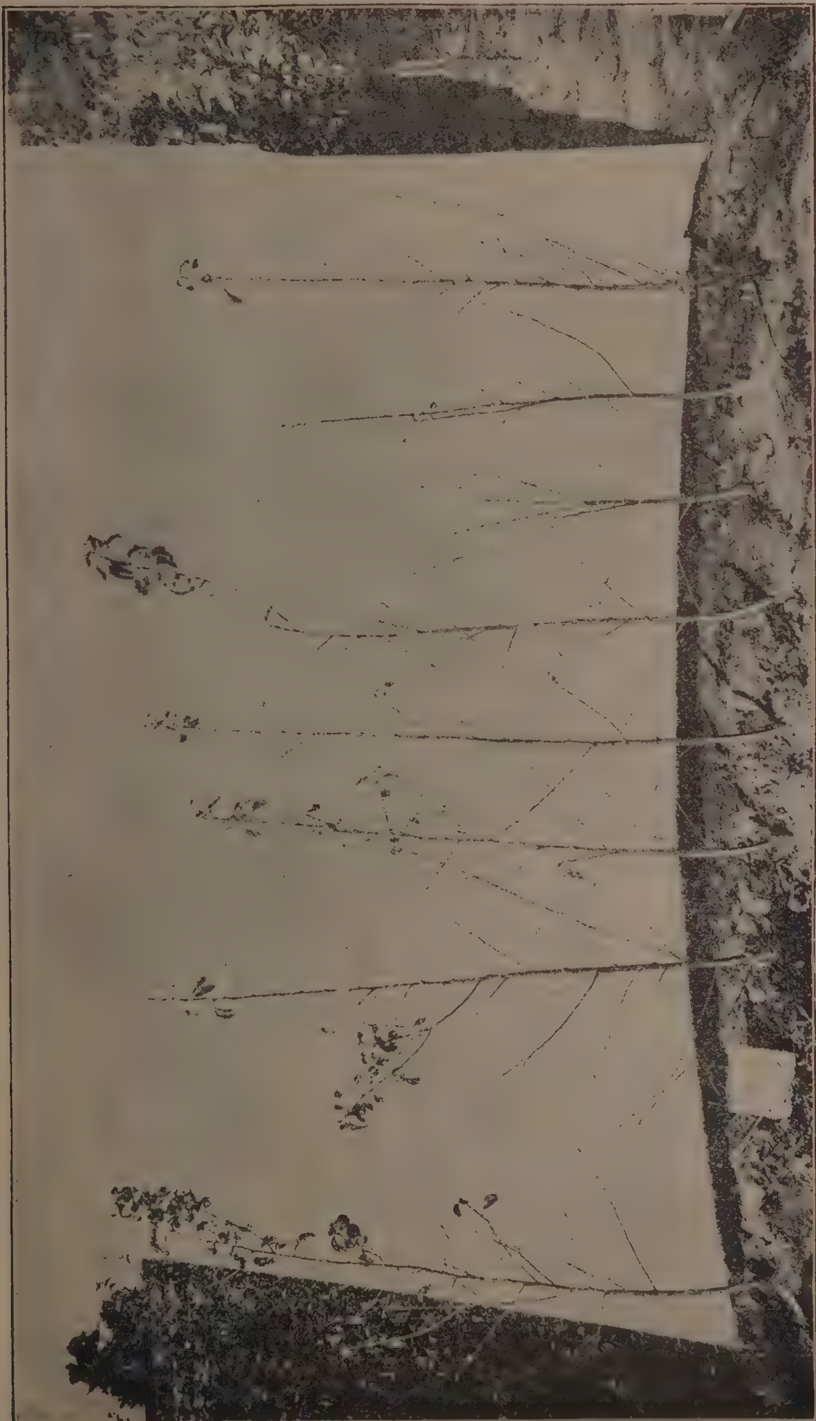
Windsor buds on Mahaleb stocks. Treated with Bordeaux mixture. (Fairchild.)

Cherry Leaf-blight.

Windsor buds on Mahaleb stocks. Untreated. (Fairchild.)

Plum Leaf-blight.

Early Prolific buds on Myrobolan stocks. Treated with Bordeaux mixture. (Fairchild.)



PLUM LEAF-BLIGHT.

Early Prolific buds on Marianna stocks. Untreated. (Fairchild.)

The treatments were begun in 1891 about three weeks after planting, when the first leaves were nearly three-fourths grown. The dates upon which the applications were made were May 21, June 3, June 24, July 9, July 24, August 8, and August 28. As indicated above in the plan, half of each section was treated three times. Those treated three times were sprayed on the first three dates mentioned.

In 1892 the treatments were begun on May 26, when the leaves had attained full size, and the first appearance of the disease was observed. The dates of treatment are May 26–27, June 15–16, June 23, July 6–7, July 21, and August 5. In order to apply the mixture more thoroughly the spray was passed rapidly over the plants and the operation repeated after the first spraying had dried.* This method insured as near a complete coating of the fungicide as possible, and it was found that the Bordeaux mixture of this weak strength adhered with remarkable tenacity, being plainly visible twelve weeks after application.† Care was taken to spray the under side of the leaves on the cherry and plum stocks, but pear, quince, and apple stocks were sprayed from above.

The treatments of 1892 were not continued so late in the season as those of 1891, and the different sections received respectively five and six sprayings, instead of three and six as in 1891. Those receiving five sprayings were treated on the first five dates mentioned above. The actual amount of the fungicides used will be of little value in estimating the quantities that will be necessary in treatments on a large scale, but for the convenience of other experimenters it may be roughly estimated to equal 3½ to 4½ gallons of solution per 1,000 one-year-old stocks and proportionately more for budded stocks. By one-year-old stocks is meant stocks previous to budding.

The spraying was done with a W. & B. Douglass "Perfection" knapsack sprayer, which proved moderately satisfactory, although a hand-wheel machine would undoubtedly have been better.

DESCRIPTION OF PLATES.‡

PLATE XXI. French pear stocks, planted in 1891 and treated 7 times with Bordeaux mixture, full strength; left unbudded in the fall and treated 6 times with Bordeaux, one-third strength, in 1892. These could properly be called 3-year-old seedlings. Situation of stocks, Row VIII, east end.

XXII. French pear stocks, similar to those in Plate XXI, but without treatment either in 1891 or 1892. Situation of stocks, Row VI, east end. Showing defoliation caused by *Entomosporium*.

XXIII. French pear stocks, similar to those in Plate XXI, but treated 7 times in 1891 and 6 times in 1892 with ammoniacal solution. Situation of stocks, Row VIII, near center.

XXIV. Angers quince stocks, planted as cuttings in 1891 and treated 7 times with Bordeaux full strength the first season, left unbudded in the fall, and treated 6 times with Bordeaux one-third strength in 1892. These could properly be called 3-year-old cuttings. Situation, Row V, near east end.

XXV. Angers quince stocks, similar to those in Plate XXIV, but without treatment either in 1891 or 1892. Situation, Row V, east end, one rod east of those in Plate XXIV. Showing defoliation by *Entomosporium*.

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* Suggested first by N. A. Cobb, Dialogue concerning the manner in which a poisonous spray does its work in preventing or checking blight. <*Agricultural Gazette N. S. Wales*, Vol. II, pp. 779–786.

† These double sprayings were made on the first, fourth, fifth, and sixth treatments only.

‡ All plates are reproduced from photographs taken 8 feet from the stocks on September 29 and October 11.

PLATE XXVI. Windsor "buds," on Mahaleb. The Mahaleb stocks were treated 7 times in 1891 with Bordeaux mixture and the "buds" were treated 6 times in 1892 with Bordeaux one-third strength. Situation, Row I, near west end.

XXVII. Windsor "buds," on Mahaleb. Similar to those in Plate XXVI, but untreated both in 1891 and 1892. Situation, Row I, near east end, showing defoliation by *Cylindrosporium*.

XXVIII. Early Prolific "buds," on Myrobolan. The Myrobolan stocks were treated 7 times in 1891 with Bordeaux and the "buds" were treated 6 times with Bordeaux one-third strength in 1892. Situation, Row III, west end.

XXIX. Early Prolific "buds," on Marianna. Similar to those in Plate XXVIII, but untreated both in 1891 and 1892. (The difference of stocks upon which budding was done made no difference as regards the leaf-blight; hence the fact that the "buds" in Plate XXVIII were on Myrobolan stocks and in Plate XXIX were on Marianna does not affect the comparison.) Situation, Row IV, east end.

EXPERIMENTS WITH FUNGICIDES IN THE REMOVAL OF LICHENS FROM PEAR TREES.

By M. B. WAITE.

(Plates XXX, XXXI.)

While conducting experiments in the large Bartlett pear orchard near Scotland, Va., on the James River, owned by the Old Dominion Fruit Company, the abundance of lichens on the trees attracted attention. Below are given a few notes on their occurrence, and some observations on the effects of Bordeaux mixture and other fungicides upon them.

Lichens are not ordinarily regarded as injurious to the trees on which they grow. They are epiphytic rather than parasitic, many species living on old fences and rocks, as well as on the bark of trees. Orchardists are more apt to regard them as injurious than botanists, the former generally looking upon them as obnoxious. The fact that various washes have been recommended to be used on fruit trees against the lichens as well as the insects they foster, is some evidence of this. Scraping the bark of the trees has also been recommended for removing these pests.

Lichens seem to attack most severely trees which are not in a vigorous condition. Trees not well fed, and weakened by leaf-blight or other fungous diseases, foster them better than healthy trees and no doubt become still further weakened by their load of lichens. The question of course arises: Is the tree made less thrifty by the lichens or is it infested with lichens because it is not thrifty? At any rate trees badly infested are usually weak trees, inferior to the general average of the orchard, and present a very ragged appearance. The presence

of lichens on the trees is certainly not desirable even if not positively objectionable.

It should be noted that the lichens live not only on the rough exfoliating bark of the trunk and larger limbs, but on the smooth growing bark of the smaller branches. In fact the smooth branches seem to have considerably more on them than the old trunks. The fruticose forms are firmly attached to the smooth bark by a small, expanded, disk-like portion of the thallus. The crustaceous forms grow tightly appressed to the bark, or, according to Tuckerman,* the lowest forms grow beneath the outermost layers of the cells of the bark. We see how closely the lichen structure is united to its supporting bark. If not in actual contact it is separated from the green, living bark cells only by an exceedingly thin layer of cork three or four cells deep and not thicker than tissue paper. Furthermore, many species seem to be restricted to the smooth bark. It seems highly probably then that lichens which are in such close connection with the living bark and are more or less restricted to it, take something from the tree. Possibly this consists only of some essential mineral matters, but perhaps also of elaborated sap, and even if they take nothing from the trees their presence may seriously interfere with the functions of the bark.

The Bartlett pear orchard above mentioned has been planted about seventeen or eighteen years. The trees were headed low, and allowed to grow as low, pyramidal standards. Many of the trees had their branches completely fringed with lichens (see Plate XXX). Where the fruticose and foliaceous forms did not cover the limbs the spaces were filled with the crustaceous species. The fringe-like and foliaceous forms are more conspicuous, but the crustaceous forms are probably more injurious.

I am inclined to think that lichens, when abundant, do considerable injury to the trees, although it is hard to get any positive evidence to bear out this belief. The badly infested trees occur in this orchard in patches of several acres in extent, although almost anywhere on the 200 acres the trees were found carrying more or less of the crustaceous forms, if not the larger growths. The crust-like lichens give to the normally smooth yellow bark a grayish, dappled, or spotted appearance, noticeable from a distance.

EXPERIMENTS WITH BORDEAUX MIXTURE.

A block 10 trees square, containing in all about 80 trees, was severely pruned back, the whole top of each tree being removed, leaving only the body and main limbs. This severe treatment and the washing described below were directed primarily against a twig disease, which will be reported on at another time. The object was to remove the twigs and small branches and then to disinfect the remaining parts of the tree of all fungi, lichens, etc.

*Synopsis of North American lichens, p. VIII.

At the suggestion of Mr. Galloway, Bordeaux mixture was tried for this purpose, applied with a whitewash brush. This treatment was entirely successful against the lichens. The strength used was double that of the old formula, or 6 pounds of copper sulphate and 4 pounds of lime in 11 gallons of water. The mixture was applied to about two-thirds of the trees March 16. A storm of rain and snow freezing on the trees stopped the work, but the remaining trees were painted three or four days later. In using the mixture we had some little difficulty in wetting the lichens by means of a brush. It was slower painting a tree covered with fringe-like lichens than one with smooth bark. Ten minutes was found to be a rather short time to cover one of these small trees. Probably two minutes would suffice for thoroughly wetting the same trees with a sprayer, although a more dilute mixture would have to be used.

It was evident at the time of making the applications that the mixture was taking effect. A few minutes after being wet with the mixture the lichens assumed a greenish, ochraceous color, quite different from their normal grayish tint. On visiting the place again on April 8 examination showed that the lichens were all dead. The fruticose and foliaceous forms were drooping and shriveled, while all were colored a yellowish or brownish tint (see Plate XXXI). During the spring further opportunities occurred for observing the effect of Bordeaux mixture on lichens, while spraying trees in the same orchard for leaf-blight and other fungous diseases. For this purpose the diluted formula (6 pounds of copper sulphate and 4 pounds of lime in 50 gallons of water) was used. Although no special effort was made to spray lichens with the mixture, it was found that whenever thoroughly wet with it they were killed. The weak Bordeaux turned them yellow in the same way as did the strong mixture painted on the trees. On the foliaceous forms, whenever a few tiny drops of the spray struck, the yellow spots resulting were plainly visible. Probably the best way would be to use the regular old formula for Bordeaux and apply it with a sprayer when any considerable number of trees are to be treated, unless it should be demonstrated that the more dilute Bordeaux is equally effective.

EXPERIMENTS WITH OTHER FUNGICIDES.

The satisfactory results with Bordeaux mixture led to the belief that eau celeste might be still more effective. This fungicide is more corrosive to the leaves of higher plants, and is in solution, so that it can be absorbed by a lichen. It was also thought desirable to test different strengths. For this purpose eau celeste was made up according to the original formula, and dilutions made of part of this by adding 2, 3, and 5 parts of water to 1 part of the mixture. Each strength of the fungicide was sprayed upon the lichen-covered trunks of 3 trees until the lichens were wet. A branch of foliage on each tree was also sprayed for

comparison. At that date the petals of the pear trees were falling and the young leaves just expanding.

One week after the application notes were taken as to the effect. On each tree foliage on the sprayed branch was injured, even where the mixture was diluted 5 to 1. The injury consisted of small brown specks occurring over the leaves and larger brown spots around the margins where the liquid had collected in drops. Besides this there was a general yellow appearance and arrested growth. The one-sixth strength did very nearly as much damage as the full strength. The lichens seemed to be harmed but little. The foliaceous forms were discolored somewhat and were injured the most. They were turned slightly reddish or purplish. The fruticose forms were not visibly changed. As with the foliage, the results from using different strengths of the solution varied but little. The full strength was scarcely more effective than the one-sixth dilution. The strong solution turned the foliaceous forms a little redder and scorched the leaves a little more, the difference being only in degree. An examination of the trees in July showed no decided further change in the sprayed lichens, and altogether the effect of eau celeste was unsatisfactory and indefinite. The injury to the foliage would make no difference because the treatment could be made in winter.

At the time the experiments with eau celeste were carried on, a trial was made with chloride of lime, 1 per cent solution, and bichloride of mercury, one-tenth of 1 per cent solution. Both of these solutions caused the foliage to become of a sickly yellow color, but had scarcely any effect on the lichens. They were turned a little yellow in a few places where the solution settled in drops, but the majority looked all right.

CHEMICAL ACTION OF BORDEAUX MIXTURE ON LICHENS.

Bordeaux mixture seems to have some chemical action on the lichen substance. When a drop of it falls upon a dry lichen there is at first no visible action. In the course of a minute or two the drop, which consists of a clear liquid with the blue, flocculent copper compound suspended in it, begins to turn yellowish, and the lichen beneath it takes on the same color. That the color of the liquid was real and not due to the lichen beneath it was proved by removing a colored drop with a small glass tube, in which it still retained its yellow color. The drop gradually becomes yellow and in course of ten or fifteen minutes will disappear, partly by evaporation and partly by being absorbed by the lichen. The result is a greenish yellow spot, with a few blue grains of the copper compound on the surface. It may be that there is some substance in lichens that acts on the blue precipitate of the Bordeaux and dissolves a portion of it, otherwise how could an insoluble compound penetrate a lichen thallus and destroy it? The clear liquid separated from the blue precipitate had no such effect, nor

did the lime alone without the copper, as a trial demonstrated. There seems to be some mutual reaction between the Bordeaux and the lichen substance, probably the fungous part, since a test with unicellular algæ gave no such results. This point is worthy of further investigation, and is of interest on account of the possibility of its throwing light on the general question of the action on fungi of the copper compound in Bordeaux mixture and in other insoluble copper preparations. Microscopical examination of a small portion of a lichen thallus which had been treated with Bordeaux mixture and had turned yellowish and dried, showed no marked changes. The chlorophyll, however, had turned a brighter yellow color, and to this is probably due the general change of color.

SUMMARY.

(1) Bordeaux mixture is an effective remedy for lichens on pear trees.

(2) Eau celeste, chloride of lime, (1 per cent solution) and bichloride of mercury, (one-tenth of 1 per cent solution) proved unsatisfactory.

(3) There seems to be a reaction between the lichens and the Bordeaux mixture in which the flocculent precipitate constituting the active principle of the latter is probably partially dissolved and absorbed. As a result the lichens assume a yellow color and die.

DESCRIPTION OF PLATES.

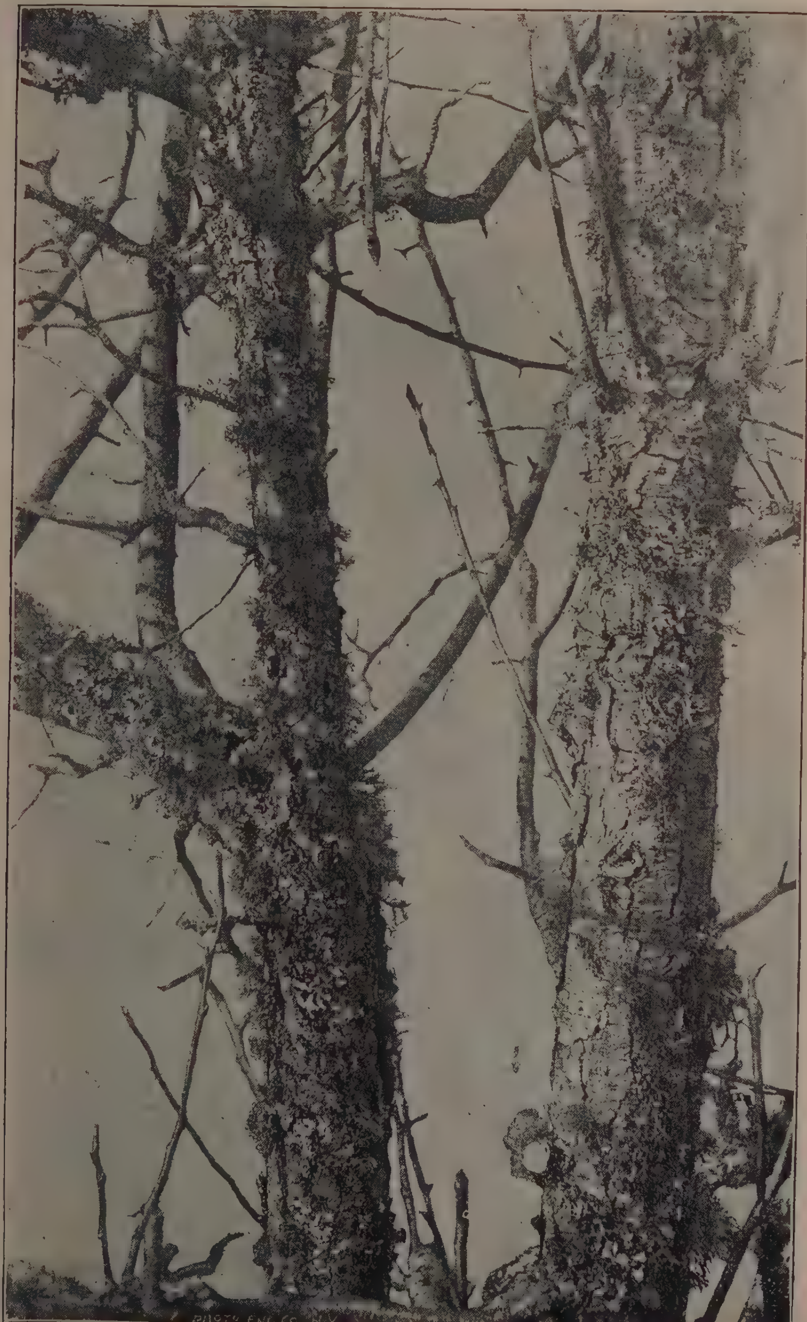
Plate XXX. A Bartlett pear tree near Scotland, Va., infested with lichens. From a photograph taken October 19, 1892.

XXXI. Bartlett pear tree in the same orchard which had been treated with Bordeaux mixture, showing the dead and shriveled remains of the lichens. From a photograph taken October 19, 1892.

NOTES ON FOSSIL FUNGI.

By Joseph F. James.

The enormous number of species and individuals of living fungi presupposes their existence in the past. But their evanescent nature and their peculiar structure render their occurrence in a fossil state comparatively rare. There is great difficulty in keeping many of them with all the care and experience of botanists, and it is natural to expect the vicissitudes of time will operate against rather than in favor of their preservation. During those periods of geological time when vegetation was mainly confined to the sea, we can scarcely expect to find fungi, so that not until the Devonian epoch need we look for evidences of their presence. The Carboniferous period, however, with its



Branches of Bartlett Pear Tree Untreated and Covered with Lichens. (Waite.)

wonderful richness of vegetation, might be expected to produce a greater or less number of species. As a matter of fact, however, they have so far been very rarely found in this formation, and it seems doubtful whether some of those that have been described as fungi are really such. Perhaps the preponderance of ferns, lycopods, and similar forms may partly explain the absence of parasitic fungi, for we know that these plants in our days are rarely attacked by them. The peculiar conditions of deposition of the coal also militate against the preservation of saprophytic forms. Experiments made by Lindley about 1835 to ascertain the probability of plants being preserved in water show that of 3 species of woody fungi only shapeless masses remained at the end of two years.* In Cretaceous and Tertiary times, when the higher types of dicotyledons predominated, parasitic species are more likely to occur, and here they are not uncommon. In the following notes upon some of the species described as fungi and occuring in the older geological formations an endeavor has been made to ascertain their actual position.

The earliest described species, supposed to be a fungus, to which reference has been found was named by Lindley and Hutton in 1831, *Polyporites bowmanni*.† The authors considered it doubtful whether it really belonged to the vegetable kingdom, but they compared it with certain fungi having a hymenium, like *Boletus*, *Polyporus*, etc. In 1877 Lesquereux‡ referred to the species and discussed its nature, stating that a specimen somewhat similar had been found in the anthracite Coal Measures near Pottsville, Pa. It did not, however, throw any light upon the true nature of the fossil. It is compared to certain shaly fragments colored in concentric zones by iron, and which occur in the Tertiary lignite of the Rocky Mountains. Finally, in 1889 William Carruthers stated that instead of its being a fungus it had been ascertained to be the scale of a ganoid fish.§ Thus *Polyporites bowmanni* was at last disposed of.

In 1869 Hancock and Atthey published a paper "On some curious fossil fungi from the black shale of the Northumberland coal field."‖ They stated that in the interior of certain lenticular bodies they found numbers of ramifying tubes. They were not calcareous, and were considered to be fungi. A comparison was made with *Sclerotium stipitatum* B. & C., 1862, and the statement made that the description of that species would fit one of the fossil forms very well. Some of the lenticular bodies appear homogeneous, but this is considered merely apparent.¶ Occasional oval, spore-like bodies were found in the threads, and scattered through the substance of the fungus. In

* Fossil Flora of Great Britain, by Lindley and Hutton, Vol. III, 1837, p. 5.

† Loc. cit., Vol. I, 1831–'33, p. 185, pl. 65.

‡ Proc. Am. Phil. Soc., Vol. XVII, 1877, p. 173.

§ Proc. of the Geol. Asso., Vol. XI, London, 1889, p. xxi.

‖ Ann. & Mag. Nat. Hist., 4th ser., Vol. IV, 1869, pp. 221–228, pls. ix, x.

¶ Out of 126 sections made, 16 appeared homogeneous.

some cases there was an outer part composed of two or three layers. The forms were referred to the genus *Archagaricon* (p. 226), with five species, as follows: *A. bulbosum*, *A. globuliferum*, *A. radiatum*, *A. dendriticum*, and *A. conglomeratum*. The first (*A. bulbosum*) is the only species illustrated. It is probable that these bodies are really fungoid in their nature, but it seems scarcely justifiable to make so many species.

In 1877 Worthington G. Smith referred to this paper* and said that while one of the figures might pass for a species called by himself *Peronosporites antiquus*, "drawn by a bad draftsman, unacquainted with fungi," the descriptions were too indefinite to determine what the writers really had in mind.

In this same paper† Mr. Smith described a fungus under the name mentioned above. He observed it in the stem of a species of *Lepidodendron* from the Coal Measures, and described the hyphæ as septate and bearing oögonia, which contained zoöspores. Further, he stated that an enlargement of the fossil to 400 diameters showed the oögonia to be the same in size and character as similar structures belonging to the potato fungus. The average number of zoöspores in each he said was also the same, namely, seven or eight. While these observations of Mr. Smith have been criticised in many quarters,‡ it is probable that the body described is a fungus. Mr. Carruthers considers it to be such, without question. In his "Diseases of Field and Garden Crops," published in 1884, Mr. Smith referred to the criticisms that had been passed upon the fossil from time to time, and reiterated his statement that traces of zoöspores are visible in the oögonia. In Massee's recent volume,§ the subject is again discussed, and the conclusion is that the species is perhaps as well placed in the *Peronosporeæ* as in the *Saprolegnieæ*, where Williamson thought it belonged.

It should be mentioned here that DeBary has questioned the accuracy of Smith's observations in regard to the presence of oöspores and zoöspores in the living *Phytophthora infestans*. Sexual organs, however, have been observed in another species of the genus (*P. omnivora*),‖ and their presence may yet be demonstrated to the satisfaction of all in *P. infestans*. DeBary says that "septa occur in the mycelium of *P. infestans*, especially when old, but they are always isolated and very irregular." ¶ The imperfect preservation of the fossil *Peronosporites* probably accounts for the conflicting statements that have been made in regard to it. It is, too, scarcely to be expected that

* Gard. Chron., new ser., Vol. VIII, London, 1877, p. 499.

† A fossil Peronospora (*Peronosporites antiquus* W. Sm.).

‡ By Murray in the Academy, Nov. 17, 1877, who denied the existence of the zoöspores; and by Williamson in the Philosophical Transactions of the Royal Society of London Vol. CLXXII, p. 299. The latter stated that the relations of the fungus were more probably with *Saprolegniæ* than *Peronosporeæ*.

§ British Fungi: Phycomycetes and Ustilagineæ, London, 1891, pp. 213–216.

‖ Bennett & Murray, Cryptogamic Botany, 1889, p. 327.

¶ Jour Roy. Agric. Soc. England, Vol. XII, London, 1876, p. 262.

it will ever be found so excellently preserved as to settle positively its true position in classification. Bennett and Murray state that "mycele and bodies which may well be oögones are visible in the preparations" of Mr. Smith.*

A remarkable paper on fossil plants by Prof. P. Martin Duncan, has been published in the proceedings of the Royal Society of London.† The title is, "On some Thallophytes parasitic within recent Madreporaria." In the course of the paper he refers to the work of other writers on organisms in corals. The time range of the various parasites is very great, as corals from the Lower and Upper Silurian and Tertiary formations show their presence. In the latter case even the cell wall is preserved. Their vertical range in the ocean extends from the surface to a depth of 1,095 fathoms, and they can exist under temperatures ranging from 39.7° to that of the surface water. The parasitic growths are observed by means of thin transverse and longitudinal sections. Age and length of time since the canals were bored seem to have no influence on them, for they are just as perceptible in Tertiary as in recent corals. The usual appearance of the canals is that of long, dark lines, with a clear central space. The lines may branch, but are of the same size in stem and branch. Swellings are frequent and granular masses often fill spaces in the canals. Prof. Duncan proposes for the parasite the name of *Achlya penetrans*. In regard to the fossil forms he says:

> From the results of my examination of Upper Silurian corals and of Lower Silurian arenaceous Foraminifera, it is evident that a parasite closely resembling *Achlya penetrans* lived within them during those remote ages. Corresponding in shape with the Silurian form of parasite are others which are fossil within the corals of later ages. The main differences between the ancient and modern forms consist in the larger caliber of some of the filaments of the first, their long, often unbranching course, and the frequent development of *Conidia*-looking bodies within them, and the spherical shape of the spores; but it is quite possible that these are not distinctions which are of specific value.
>
> The modern coral parasite is evidently the descendant, with slight, or possibly no modification, of those which have flourished during successive world-wide changes in floras and external conditions. Hence it would, in all probability, have had its life cycle made complicated, and a metamorphosis involving vegetative and mobile stages has been superadded. It is not an assimilator of putrescent or rotten animal matter, but of the nitrogenous and undecomposed organic basis of the coral; and in this it resembles the organisms which destroy some living diptera and other aërial insecta. Moreover this resemblance in function is possibly caused by continuance of individuality; and if this be true, it adds vastly to the difficulty of placing the parasite in a philosophical scheme of classification (pp. 252-253).

The lowly organization and the simple structure of many fungi have been the possible cause of the continued existence of many of them through long periods of time. We seem scarcely prepared, however, to realize that the forms existing as parasites within corals of Silurian

* Loc. cit., p. 330.

† Abstract in No. 171, Vol. xxv, 1876, pp. 17-18; complete in No. 174, Vol. xxv, 1876, pp. 238-257, pl. 3.

age are the same as those now living in inhabitants of the ocean. Still when we remember that the fungus simply produces threads or filaments with the occasional addition of spores; that the bathymetrical conditions have probably remained nearly the same, and that the hosts alone have changed since early geological time; and further that the fungus causing potato rot had at least its representative in plants of Carboniferous age, it does not seem so strange to find long-lived forms under other conditions. If, however, the parasitic *Achlya penetrans* of modern seas is identical with the parasite of Silurian seas, the case is without a parallel in the organic world.

In 1877 Prof. L. Lesquereux published a paper entitled "A species of fungus recently discovered in the shales of the Darlington coal bed (Lower Productive Coal Measures Allegheny River series) at Cannelton, in Beaver County, Pa."* The name *Rhizomorpha sigillariæ* is given to the specimen, which was found beneath the bark of a species of *Sigillaria*. A figure of it was sent to Dr. Casimer Roumeguere, of Toulouse, France, who concluded that it bore a great resemblance to living examples of *Rhizomorpha*. The figure given by Lesquereux is reproduced below. (Fig. 1.)

Fig. 1.—*Rhizomorpha sigillariæ*. Lesqx.

The striking resemblance which this figure had to certain insect burrows under the bark of trees was pointed out by the writer in 1885† and a further examination confirms this belief in its origin. The genus *Rhizomorpha* is now recognized as simply the sterile mycelium of various species of fungi. This fact does not of course militate against the fossil being a fungus, but if comparison be made between it and the burrows of various living insects, the resemblance is most marked. Some of these are shown in the figures given on the following page (figs. 2 and 3).

The burrows, although more or less constant in form for each individual species, present great variations. With a sufficiently large series of examples it might be possible to find some presenting a greater resemblance to the fossil, but the general aspect of the modern insect mines is sufficient to induce the belief that the supposed fossil is not a fungus but an insect burrow. This fact is rendered the more probable when it is remembered that remains of insects are found in the same beds as those containing the fossil *Rhizomorpha*.

*Proc. Am. Phil. Soc., Phila., Vol. XVII, 1887, pp. 173–175.

† Remarks on a supposed fossil fungus from the Coal Measures. Jour. Cin. Soc. Nat. Hist., Vol. VIII, 1885, pp. 157–159.

Another fossil described as a fungus was later on shown not to be such. It was originally named by Goeppert *Gyromyces ammonius*. It

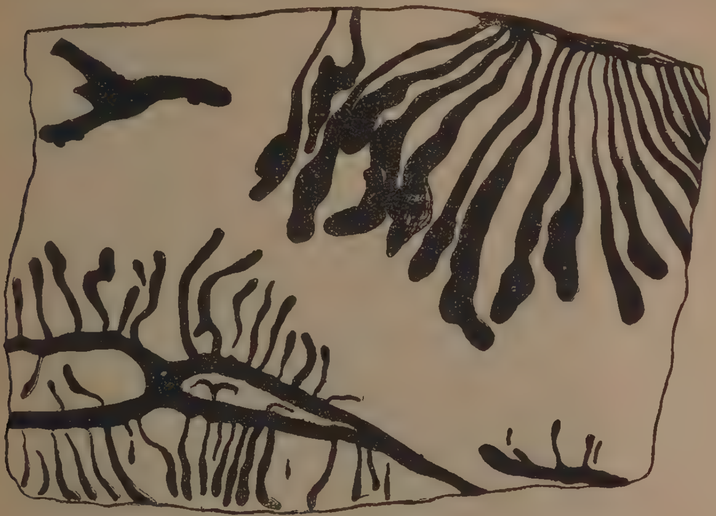


FIG. 2.—Larval burrow of *Bostrychus typographus*. Nat. size. (After Hess.)

was found in Saxony under the bark of certain coal plants and subsequently in rocks of Carboniferous age in North America. It has been shown by Dawson to be really the spiral tube of an annelid, and was

FIG. 3.—Burrow of *Carphoborus bifurcus*. Nat. size. (After Packard.)

named by him *Spirorbis carbonarius*. Lesquereux also considered the fossil to belong to the animal kingdom and figured it as such in volume 2 of the Geological Survey of Illinois, 1866 (p. 462, pl. 38, fig. 6).

DESCRIPTIONS OF SOME NEW SPECIES OF FUNGI.

By J. B. Ellis.

Podaxon mexicanum *n. sp.*—On the ground in a garden, near the bay, at Agia Bampo, Sonora, Mexico, November, 1890. (Dr. Edward Palmer.) Whole plant, 4–8^{cm} high. Stipe about 1^{cm} thick at the base, tapering above and running through to the vertex of the peridium; subbulbous, hollow, the cavity at first filled with silky fibers. Flesh white, except at the point where it enters the peridium, where it is of a bright orange color (within). Peridium ovate, 2–3½^{cm} high, 2–3^{cm} wide, thin, white, and like the stipe clothed with broad, yellowish, appressed scales, attached to the stipe below at first, then separating, with the margin lacerate-sublobate. Capillitium attached to the stipe or to the inner surface of the peridium, consisting of branching, yellowish threads 3–8μ in diameter, with abundant yellowish olive globose or ovate, 8–12μ spores, with some larger (12–15μ) ones intermixed.

Uromyces rhyncosporæ *n. sp.*—On *Rhyncospora glomerata*, Pennsville, Salem County, N. J., October, 1881. (A. Commons.) I and II not seen. (III.) Sori hypophyllous, scattered or aggregated and subconfluent, orbicular or subelongated, ½–1^{mm} in diameter, black, naked, and loosely embraced by the margin of the ruptured epidermis. Teleutospores clavate, 20–25 by 8–12μ, strongly thickened and darker colored at the apex, which is generally at first prolonged into a beak 10–12μ long, making the spore lanceolate; sometimes this beak is permanent, but oftener the spore becomes obtuse or even squarely or obliquely truncate. Pedicels 20–25μ long, subequal or slightly thickened at the base, hyaline or yellowish. [This species is different from *Uromyces caricis* Peck, which has been shown by Dietel, in *Hedwigia*, vol. 28, p. 22, to be the uredo of *Puccinia caricis-stricta* Dietel.—Ed.]

Puccinia microica *n. sp.*—On *Sanicula* (?), Garrett Park, Md., May, 1890. (E. A. Southworth.) Æcidia hypophyllous, crowded on slightly thickened suborbicular spots 1½–2^{mm} across, papilliform and closed at first, then open, shallow, cup-shaped, ¼^{mm} in diameter, with a narrow granular-stellate, evanescent border. Spores orange, subglobose 15–22μ, or more or less irregular. Uredospores in the same sori with the teleutospores, not abundant, subglobose, pale, faintly aculeolate, 18–22μ in diameter. Teleutospores in minute sphæriiform sori mixed with the æcidia, about ½^{mm} in diameter, at first covered by the epidermis, then naked above and dark brown, mostly biconical (some of them oblong or elliptical), slightly constricted, pale brown, with a small, prominent hyaline, central or oblique papilla at the apex, 25–45 by 14–20μ, with very short pedicels. Epispore smooth.

Puccinia montanensis *n. sp.*—On *Elymus condensatus*, Helena, Mont., July, 1891. (Rev. F. D. Kelsey.) I and II not seen. (III.) Sori mostly linear, lying between the nerves of the leaf and often con-

fluent for 1^{cm} or more long, so very abundant as to blacken the leaf, hypophyllous, black, at first covered by the epidermis, but soon bare, not prominent. Teleutospores ovate or elliptical, 25–50 by 15–22μ, sessile or nearly so, moderately constricted at the septum, apex rounded or flattened, sometimes obliquely flattened, strongly thickened, but not papillate, darker colored and mostly shorter and broader than in *P. rubigo-vera*. The sori are mostly surrounded by paraphyses. The habit also is different.

PUCCINIA SUBCOLLAPSA *n. sp.*—On leaves and stems of some plant of the order *Asclepiadaceæ*, collected in South America by Thomas H. Morong. (Communicated by Mrs. E. G. Britton.) (III.) Sori amphigenous, hemispherical, chestnut-colored, $\frac{1}{3}$–$\frac{1}{2}^{mm}$ in diameter, thickly and quite evenly scattered over the leaves and stems. Teleutospores ovate, elliptical or subglobose, 18–22 by 12–15μ, slightly constricted in the middle, pale brown. Epispore thin and smooth, often collapsing at the apex and sometimes also at the base, causing the two cells to appear as if pressed together and giving the spore a subcubical shape. Pedicels slender, about 60–75μ long, attenuated below and hyaline, slightly colored above. Some of the spores are without septa. Differs from *P. heterospora* B. & C. in habit and in its thin-walled, after collapsed teleutospores.

UREDO ERIOCOMÆ *n. sp.*—On leaves of *Eriocoma cæspitosa*. Mohave Desert, Kern County, Cal., May, 1892. (D. W. Coquillett.) Sori hypophyllous, oblong, 1–4^{mm} long, pulvinate, soon naked, dark chestnut color. Uredospores globose, 20–25μ in diameter, or ovate 22–30 by 20–25μ, hyaline at first, soon becoming chestnut brown. Epispore thick, nearly equally so all round, short tubercular-spinulose; pedicels short, equal, hyaline. Differs from *U. bouteloua* Arthur in the absence of any spots, the larger sori, and equally thickened epispore.

UREDO SIMILIS *n. sp.*—On leaves of *Lycium vulgare*. Brookfield, Ind., November, 1890. (E. M. Fisher, No. 417.) Sori amphigenous, orbicular, $\frac{1}{2}^{mm}$ in diameter, yellow, becoming pale brown, scattered, flattened, not on spots. Spores obovate, 22–35 by 15–20μ, rounded and slightly thickened and aculeate above, narrowed and smooth below, hyaline, becoming yellow. Pedicels very short. Differs from the *Uredo* of *Puccinia lycii* Kalch. in the absence of any spots and in its larger, obovate spores. *P. afra* Winter has uredospores aculeate above and smooth below, but oblong and larger. *P. tumidipes* Pk. also has larger uredospores aculeate at both ends. Possibly our Uredo may prove to belong to *Puccinia globosipes* Pk., of which the uredoform is as yet unknown.

TILLETIA RUGISPORA *n. sp.*—In ovaries of *Paspalum plicatulum*. College Station, Brazos County, Tex., 1889. (T. L. Brunk.) Mass of spores snuff-gray, filling the ovaries. Spores globose, rather pale brown, 15–22μ in diameter, tuberculose reticulate, the reticulations about 1μ high and $1\frac{1}{2}\mu$ broad. The affected ovaries are scarcely changed in outward appearance.

ASTERNIA RADIANS *n. sp.*—On living leaves of *Capparis cynophallophora.* Florida, 1891. (No. 256, Simpson's collection.) Perithecia hemispherical, black, rough, with a black, shiny, compressed or subpyramidal ostiolum, finally collapsing slightly above; about $\frac{1}{4}$mm in diameter; hemispherical; densely crowded and radiately arranged in orbicular patches 3–4mm in diameter on the upper side of the leaf. Asci elliptical, briefly stipitate, 35 by 20μ, distinctly paraphysate, paraphyses slightly thickened at the apex. Sporidia 8 in an ascus, ovate, 12–15 by 5–5$\frac{1}{2}\mu$, uniseptate, slightly constricted at the septum, yellowish hyaline, becoming brown.

ACANTHOSTIGMA FRAXINI *n. sp.*—On leaves of living *Fraxinus americana.* Near Washington, D. C., August, 1889. (M. B. Waite.) Perithecia epiphyllous, scattered, superficial, black, sub-hemispherical, about 150μ in diameter, of parenchymatous texture (astomous?), covered with short, black, scattering, spreading bristles 30–40 by 4μ. Asci subovate, about 35 by 15μ, short-stipitate 4 (–8)? spored. Sporidia (as far as seen) 4 in an ascus, clavate, 3–4-septate, 25–30 by 4–5μ, deeply constricted at the septa, yellowish or greenish hyaline. The upper cell of the sporidium is elliptical and broader and shorter than those below. The leaf is mottled with reddish brown spots and the perithecia are scattered alike over these spots and over the green parts of the leaf.

CONIOTHYRIUM MUSCICOLUM *n. sp.*—On capsules of *Polytrichum.* Carlin, Va., August, 1892. Perithecia lenticular; membranaceous, black, astomous, 75–90μ in diameter, covered by the thin epidermis, through which it is distinctly visible. Sporules globose, yellow brown, 8–10μ. This resembles outwardly *Stagonospora rauii* Ell. on the same host, but the sporules are very different.

STAGONOSPORA BACCHARIDIS *n. sp.*—On living leaves of *Baccharis.* Virginia Beach, Va., under pine trees, May 28, 1891. (W. T. Swingle.) Epiphyllous. Perithecia superficial or nearly so, hemispherical, 110–120μ in diameter, broadly perforated above, black, of tolerably coarse cellular texture. Conidia broad-fusoid, yellowish hyaline, 2-septate, nearly straight, 25–30 by 6–7μ, arising directly from the cells of the proligenous layer, with no perceptible basidia.

SEPTORIA AMPELOPSIDIS *n. sp.*—On leaves of *Ampelopsis quinquefolia.* Oregon, Ill., September 14, 1889. (M. B. Waite.) Spots numerous, angular or otherwise irregular, limited by the veinlets of the leaf, subconfluent, greenish at first, becoming dark brown, occupying the greater part of the leaf, which becomes mottled with yellow. Perithecia buried in the parenchyma of the leaf, but prominent on both surfaces, subglobose, 80–100μ in diameter, perforated. Sporules vermiform or clavate-cylindrical, hyaline, 30–50 by 3–3$\frac{1}{2}\mu$, 4–8-septate. This approaches *Cylindrosporium* on account of the imperfectly developed perithecia.

SEPTORIA MICROSPORA *n. sp.*—On leaves of *Asprella hystrix.* Crawfordsville, Ind., August, 1890. (E. M. Fisher, No. 101.) Perithecia

innate, small, about 30μ in diameter, visible on both sides of the leaf, but more prominent and mostly opening on the upper side, pale, seated on rusty yellowish or reddish brown, elongated, narrow, subconfluent spots. Sporules cylindrical, continuous, 6–12 by 1–1¼μ. The leaves finally become rusty brown and dead, especially at the points.

SEPTORIA LEUCOSTOMA *n. sp.*—On living leaves of *Fraxinus americana.* Urmeyville, Ind., August, 1890. (E. M. Fisher, No. 136.) Spots reddish brown, irregular in shape, 1¼–½^{cm} in diameter, or by confluence occupying a large part of the leaf, surrounded by a yellow, shaded border about the same on both sides of the leaf. Perithecia scattered on the spots, large, 200–230μ in diameter, lenticular, amphigenous, but more prominent on the upper side of the leaf, pierced with a large, round, white-margined opening above. Sporidia fusoid, mostly strongly curved, nucleate, becoming about 3-pseudoseptate, 20–30 by 2½μ. Seems to differ from *S. elæospora* Sacc. in its much larger perithecia and strongly curved sporidia.

SEPTORIA PIMPINELLÆ *n. sp.*—On leaves of *Pimpinella integerrima.* Winona, Minn., August, 1888. (J. M. Holzinger.) Perithecia amphigenous, scattered, not on any spots, erumpent, 120–130μ in diameter. Sporules short (15–20μ), curved, continuous, hyaline, about 1¼μ thick at the broader end, resembling the sporules of a *Phlyctæna.* Some of the perithecia contain short, oblong fusoid 2-nucleate sporules 6–9 by 2½μ, hyaline (*Phyllosticta* sp.). The *Septoria* has the sporules shorter than in any of the other described species on *Umbelliferæ.*

SEPTORIA RUMICIS *n. sp.*—On leaves of *Rumex* sp. Winona, Minn., August, 1888 (J. M. Holzinger), and Champaign, Ill., September, 1889. (M. B. Waite.) Spots amphigenous, grayish brown, becoming rusty brown and paler in the center, with a narrow, slightly raised border surrounded by a dark-shaded border while the leaf is fresh, 3–4^{mm} in diameter. Perithecia punctiform, brown, scarcely visible, buried in the substance of the leaf with only the minute apex showing, most distinct on the lower surface of the leaf, but also visible above. Sporules cylindrical, curved, obtuse, continuous, faintly nucleate, subequal, 15–25 by 1½–2μ.

PHLYCTÆNA ANDERSONI *n. sp.*—On dead stems of *Arabis holbœllii* and *Draba* sp. Sand Coulee, Cascade County, Mont., July, 1888. (F. W. Anderson.) Perithecia gregarious on pale spots, subcuticular, conic-globose, at length collapsing, raising the epidermis into little black pustules, having the aspect of a *Sphærella.* Sporules fusoid arcuate hyaline, acute at each end, continuous, 12–15 by 2½μ. Some of the pale spots on which the perithecia are seated are tinged with rose color.

CYLINDROSPORIUM STACHYDIS *n. sp.*—On *Stachys palustris.* Champaign, Ill., September, 1888. (M. B. Waite.) Spots amphigenous, small (1–2^{mm}) rusty brown, becoming nearly black, with a whitish center, subangular and tolerably well defined. Acervuli small, innate, slightly

prominent on the lower surface of the leaf. Conidia filiform, mostly curved, a little thicker at one end, subobtuse, hyaline, multinucleate, becoming multiseptate, 35–50 by 2μ, erumpent below and whitening the surface of the spots. This differs from the specimen of *Septoria stachydis* Rob. in Desm., Plantes Crypt., 1712, in its smaller, darker, more definitely limited spots, and its thicker, multinucleate conidia.

STILBOSPORA VARNEYANA *n. sp.*—On dead twigs. Grounds of the Department of Agriculture, Washington, D. C., September, 1891. (Collected by F. W. Anderson, communicated by May Varney.) Acervuli subcutaneous, subtuberculiform-prominent, conidia oblong-elliptical, 3-septate, not constricted, hyaline at first, soon becoming dark brown and opaque, except the terminal cells, which are small and remain subhyaline, 15–25 by $12–14\mu$. Differs from *S. angustata* Pers. in its smaller conidia, with the end cells hyaline.

TUBERCULINA SOLANICOLA *n. sp.*—On fruit of eggplant. Fla. (C. E. Smith.) Acervuli erumpent, tuberculiform, $\frac{1}{3}^{mm}$ in diameter, at first pale, becoming darker when dry, gregarious on pallid spots, 1^{cm} in diameter, or by confluence more. Basidia 12–15 by $2–2\frac{1}{2}\mu$, guttulate, hyaline, attenuated and slightly curved above. Conidia elliptical, 2-nucleate, hyaline, 5–7 by $2\frac{1}{2}–3\mu$. Differs from the other species of this genus in not being (so far as yet known) associated with any Uredinous fungus.

FUNGI DESCRIBED IN RECENT REPORTS OF THE CONNECTICUT EXPERIMENT STATION.

By ROLAND THAXTER.

In the reports of the Connecticut Station for 1889–'91 the writer had occasion to publish descriptions of certain new species of fungi which it seems desirable to duplicate in a form more permanent and readily accessible than that afforded by the somewhat evanescent Experiment Station literature, and through the courtesy of the editor of the JOURNAL the descriptions in question are appended, with a few additional notes.

UROCYSTIS HYPOXYIS Thaxter.

Ann. Rep't. Conn. Agr. Exp. Sta. in descr. of Pl. II, following p. 153: Pl. II, Figs. 12–14, New Haven, April, 1890. Ellis N. A. F., Cent. XXVII, No. 2688. Sacc. Syll., Vol. IX, p. 290. Pazschke, Hedwigia, 1892, p. 94.

Spore masses black, in flowers (filling ovary), pedicels, and peduncles (only near summit). Spore balls very irregular in size and shape, roundish or long oblong, the largest 50–60 by 50μ, the smallest about 25 by 25μ. Resting spores brown, spherical or somewhat polygonal from pressure, one to ten, rarely 14 to 15 in number, $13–15\mu$. Pseudospores numerous, and when the resting spore is single about 8 to 10 in number, somewhat flattened, variable, $8–15\mu$ in diameter. On *Hypoxys erecta* L. June–Aug., Westville, Conn.

This species occurred abundantly in a single locality near New Haven, but has not been found elsewhere in this country. Specimens from Brazil, however, which seem to be identical with the Connecticut form, have since been received from Dr. Otto Pazschke. Since the writer's original spelling of the specific name (*hypoxys*) has been set aside in favor of *hypoxydis* by Saccardo and others who have had occasion to mention it, some pains have been taken to ascertain from classical authorities, both at New Haven and at Cambridge, exactly what the spelling of such a genitive should be. Although the authorities in question were unanimous in asserting that *hypoxydis* (or *hypoxidis*) was absolutely incorrect the unanimity in regard to what spelling is really correct was not so striking. The general opinion seems to prevail, however, that such a genitive, had it been used, would have had the termination *yis*, and *hypoxyis* may therefore be safely employed to designate the present form.

PHYTOPHTHORA PHASEOLI Thaxter.

Bot. Gazette, Vol. XIV, 1889, p. 273; Ann. Rep't. Conn. Agr. Exp. Sta., 1889, p. 167, Pl. III, figs. 29–37; Seymour & Earle Econ. Fungi. No. 9. Ellis N. A. F., Cent. XXVIII, No. 2707.

Mycelial hyphæ branched, rarely penetrating the cells of the host by irregular haustoria. Conidiophores slightly swollen at their point of exit through the stomata, arising singly or two to several in a cluster; simple or once dichotomously branched, and once to several times successively inflated below their apices. Conidia oval or elliptical, with truncate base and papillate apex; 35–50 by 20–24μ. Germination by zoöspores, usually fifteen in number, or rarely by a simple hypha of germination. Oöspores unknown. On pods, stems, and leaves of the Lima bean (*Phaseolus lunatus*). Sept. and Oct., New Haven, Conn.,

Although so common about New Haven this species has not, so far as the writer is aware, been observed in any other locality. Whether it is an introduced exotic or is a native form which may yet be found on some native leguminous plant, is uncertain; yet its introduction at New Haven may possibly be traced to the fact that a gentleman resident there, in whose garden the fungus was abundant, received a package of Lima beans directly from South America some years since, which, when planted, may have originated the epidemic which all the gardeners whom the writer questioned concerning it, agreed to be of comparatively recent origin. The species is mentioned by Fischer in his Phycomycetes (*Rabh. Kryptogamenfl.* Vol. I. part 4, p. 415) as an "ungenau bekannte Art;" why "ungenau" is hardly evident from the references above quoted.

GYMNOSPORANGIUM NIDUS-AVIS Thaxter.

Bull. No. 107, Conn. Agr. Exp. Sta., p. 6; also Ann. Rep't of same for 1891, p. 161. Seymour & Earle, Economic Fungi, Nos. 239 & 240.

Sporiferous masses when young, cushion-like, irregularly globose or oval, small and distinct or elongate and confluent according to the habitat; rich red brown; when mature indefinitely expanded by moisture, orange-colored. Teleutospores

two-celled, irregular in shape, broadly ovate to subelliptical or fusiform, bluntly rounded or slightly tapering toward the apex, symmetrical or often slightly bent. Average dimensions 55 by 25μ. Promycelia several, not uncommonly proceeding from either extremity. Pedicels when young often more or less inflated below the spore. Mycelium perennial in leaves, branches, or trunks of *Juniperus virginiana*, very commonly inducing a "bird's-nest" distortion.

Rœstelia stage.—Spermogonia yellowish orange, preceding the æcidia by about ten days. Æcidia hypophyllous or more commonly on petioles and young shoots, and especially on young fruit, densely clustered, brown, at first subulate, then fimbriate; the peridia splitting to the base, with its divisions slightly divergent. Peridial cells rather slender, the ridges somewhat prominent, sublabyrinthiform, horizontal or becoming inwardly oblique towards the extremities. Average measurements (towards the apex of the peridia) 7 by 18μ. Æcidiospores smooth, spherical or irregularly oval to oblong; average diameter 25μ.

Mycelium annual in the leaves of *Cydonia* (quince) and in leaves, stems, and fruit of *Amelanchier canadensis* (service berry) in June.

OOSPORA SCABIES Thaxter.

Ann. Rep't. Conn. Agr. Exp. Sta., 1891, p. 159.

Vegetative hyphæ hyaline or brownish from the general discoloration of the substratum, .4–.6μ, rarely as much as 1μ in diameter, curving irregularly, septate or pseudoseptate, branching. Aërial hyphæ at first white, then grayish, evanescent, breaking up into bacteria-like segments after producing terminal spirillum-like "spores" by the coiling of their free extremities. Forming a firm, lichenoid pellicle on nutrient jelly, and usually when growing in contact with the air producing a deep black-brown discoloration of the substratum. Producing the disease known as "Scab" on potato tubers and a similar affection of beet roots.

The measurements of the hyphæ of this form given in the original description (.6–1μ) are somewhat larger than they should be, hyphæ 1μ in diameter being very rarely seen and the average diameter being usually less than .6μ. The spiral forms are most readily seen in the grayish film developed naturally on the scab spots, though they are obtained without difficulty from the aërial hyphæ on hard agar cultures. The writer has seen no published account of further European observations upon the disease, and such accounts are to be awaited with interest. Sauvageau,* however, has apparently obtained the scab fungus accidentally from water, and described it as *Oospora metchnikowi* n. s. Although this writer does not mention the spiral "spores" the form corresponds so closely to the present species, both in structure and in its effects upon the substratum, that the identity of the two seems more than probable.

* Ann. d. l'Inst. Pasteur, t. VI, p. 242.

DESCRIPTIONS OF NEW SPECIES OF PUCCINIA AND UROMYCES.

By S. M. TRACY.

PUCCINIA ARISTIDÆ *n. sp.*—(II, III). Rarely amphigenous, usually on the inside of the sheath. Sori oval to narrowly elliptical, sometimes confluent, ruptured epidermis prominent. Uredospores brownish yellow, subglobose or oval, epispore thick, minutely tuberculate, 23–27 by 23–32μ. Teleutospores light brown, broadly oval, slightly constricted, epispore smooth, thickened at the apex, 25–28 by 40–45μ. Pedicel slightly tinted, tapering, about twice the length of the spore. On *Aristida pungens*; herb. *A. Regel*, Turkestan, 1887.

PUCCINIA PALLIDA *n. sp.*—(III). Hypophyllous. Sori small, dark, scattered. Teleutospores light-colored, clavate, constricted, apex very much thickened and rounded, or somewhat pointed, 12–14 by 42–52μ. Pedicel very short, almost wanting. On *Osmorrhiza*. Platteville, Wis., October, 1887.

PUCCINIA REDFIELDIÆ *n. sp.*—(III). Sori oval, sometimes becoming linear by confluence, black. Teleutospores dark brown, broadly elliptical or oval, constricted, epispore smooth, thickened at the apex, 23–26 by 40–45μ. Pedicel tinted, rather large, twice to three times the length of the spore. On *Redfieldia flexuosa*. Dr. George Vasey, Kansas, 1889.

UROMYCES ANDROPOGONIS *n. sp.*—(II, III). Hypophyllous. Sori oval or oblong, sometimes confluent. Uredospores light colored, subglobose, sharply echinulate, 15–17 by 16–19μ. Teleutospores dark brown, broadly oval, apex obtuse, rounded, strongly thickened, 14–16 by 24–28μ. Pedicel somewhat tinted, twice the length of the spore. On *Andropogon virginicus*. Starkville, Miss , October, 1891.

UROMYCES ERAGROSTIDIS *n. sp.*—(II, III). Amphigenous. Sori minute, scattered, long, covered with the epidermis. Uredospores light yellow, subglobose, echinulate 16–18 by 17–20μ. Teleutospores usually oval or obovate, often angular, epispore smooth, thickened at the apex, 14–16 by 22–28μ. Pedicel slightly tinted, as long as the spore. On *Eragrostis pectinacea*. Starkville, Miss., October, 1891.

UROMYCES PANICI *n. sp.*—(II, III). Hypophyllous. Sori oval or oblong, sometimes becoming confluent. Uredospores light yellow, faintly echinulate, globose, 12–16μ. Teleutospores dark brown, oval, smooth, apex thickened and sometimes beak-like, 14–16 by 26–30μ. Pedicel tapering, tinted, somewhat longer than the spore. On *Panicum anceps*. J. M. White, Martin, Miss., September, 1891.

UROMYCES HORDEI *n. sp.*—(III). Hypophyllous. Sori minute, scattered, round or oval. Teleutospores brown, quite irregular, but usually oval or broadly clavate, epispore smooth, slightly thickened above, 15–18 by 22–26μ. Pedicel very short. On *Hordeum pratense*, New Orleans, La., May, 1891.

(1) ZOPF, DR. WILHELM.—*Die Pilze in morphologischer, physiologischer biologischer und systematischer Beziehung.* Breslau, 1890, pp. iii, 500, figs. 163. Eduard Trewendt.

(2) KIRCHNER, DR. OSKAR.—*Die Krankheiten und Beschädigungen unserer landwirtschaftlichen Kulturpflanzen.* Eine Anleitung zu ihrer Erkennung und Bekämpfung für Landwirte, Gärtner, etc. Stuttgart, 1890, pp. x, 637. Eugene Ulmer.

(1) The frequent use of this book for more than a year and the recent careful reading of the whole of it preparatory to this review, have served to strengthen the first impression, viz, that for the general student it is the best handbook yet published. We miss throughout it is true, De Bary's classical style, and in places also his intimate knowledge and comprehensive grasp of details, but on the other hand there is a welcome absence of interminable minutiæ, and a certain directness and subordination of the parts to the whole that more than compensates. Naturally our first thought is to compare the book with De Bary's *Morphologie*, but the two occupy different fields. De Bary concerns himself almost exclusively with structure, delighting in a wealth of detail, very useful to the specialist, but always very discouraging to the general student, especially if to the perplexities of the subject are added a condensed style and the difficulties of a foreign language, in this case now happily overcome for English readers by Garnsey's translation.

As the title indicates, this work is an effort to cover the whole ground of morphological, physiological, and systematic mycology and, considering the difficult nature of the task, it must be said that Dr. Zopf has succeeded admirably.

The preface is dated Halle a. S., May, 1890, and the book is dedicated "*Dem Andenken von* E. Fries, Tulasne, De Bary."

The book is divided into six chapters, and perhaps no better idea can be given of the scope of the work than to translate the running heads of the chapters devoted to morphology, physiology, and biology.

Chapter I, in 27 pages discusses *The morphology of the vegetative organs:* Typical mycelium—sprout mycelium—haustoria—climbing mycelium—sclerotia—mycelial strands and pellicles—reduced mycelium.

Chapter II, in 68 pages, discusses *The organs of fructification:* Exosporous or conidial fructification, nature of conidia and mode of formation—forms of conidial organs—simple conidiophores—conidia bundles—conidia beds—conidia fruits; endosporous or sporangial fructification—simple sporangiophores—sporangial beds—sporangial fruits—structure of the mature ascus fruit—development of the sporangial fruits; zygosporous fructification; gemma (brood cells, chlamy-

dospores); monomorphism, dimorphism, pleomorphism; *Mechanical arrangements for liberating the spores:* The loosening of the conidia from each other and from their supports—the expulsion of conidia, sporangia, and fruit-forming organs—the liberation of endospores from the sporangia of the Phycomycetes—the ejaculation of spores from asci—liberation of conidia from pycnidia—liberation of ascospores from the non-ejaculatory Ascomycetes.

Chapter III, in 20 pages, treats of *Cell structure:* The membrane thickenings—foldings—differentiations—chemical nature—physical nature; plasma; cell division. *Cell formation:* Free cell formation; cell division. *Union of cells into systems (tissues):* Cell threads—cell surfaces—cell masses—hyphal tissues—fusion formation (fusion tissue).

Chapter IV, in 109 pages, treats of *The Chemical composition:* Inorganic; organic—carbohydrates—vegetable acids—aromatic acids (tannins, acids of lichens)—fats—ætherial oils—resins—colors (yellow or yellow-red oleaginous colors, *i. e.*, lipochrome)—colors not due to lipochrome—reds—greens—blues and blue greens—violets—browns—combinations with each other and with other substances—the distribution of particular colors—change of color—glycosides—plant bases (alkaloides)—cholesterin—albumen. *Foods:* Inorganic—organic—composition and combinations—chemical reactions. *Transformation, storage, secretion:* Ferments (enzymes)—inverting—starch dissolving—paramylum dissolving—cellulose dissolving—peptonizing—fat splitting—chitin dissolving; resin-like bodies and ætherial oils; colors and chromogenes; secretion of albumen and peptone; secretion of sugar; oxalic acid; other acids; ammonia; water. Respiration; fermentation (splitting—oxidation); splitting up of food materials; production of heat; production of light. *Influence of external forces on growth, fructification, etc.:* Light—temperature—mechanical movement—atmospheric pressure. *Phenomena of movement:* Heliotropism—hydrotropism—geotropism—movements due to contact—rheotropism—chemical irritation—electrical irritation—nutation—hygroscopic movements. *Life activity and life injuring agents:* Extremes of temperature—removal of water—insolation—poisons. *Mechanical means of killing or hindering development.*

Chapter V, in 57 pages, treats of the *Biology of fungi*, under the following heads: *Saprophytes*; *Parasites:* The transportation of infectious fungus germs; means and way of infection; choice of host—choice of organ; effect of parasitism in plants and animals—hypertrophy—metamorphosis—production of new growths—pseudomorphosis and mummification—destructive action; a glance at the diseases of men and animals due to fungi—invertebrates, vertebrates—fishes—birds—mammals—man: battle of the animal cells and tissues with the penetrated fungous cells. *Symbiosis:* The enemies of fungi—enemies of molds—of Saprolegniaceæ—of rust fungi—of Hyphomycetes—of Ascomycetes. *Duration of life.*

The reader who wishes a digest of what was known up to 1890 on any of these subjects can not do better than to consult this book, for if he does not there find all he needs the chances are that the footnote references to the literature of the subject will put him in the way of finding the rest.

The last half of the book is devoted to a presentation of the systematic side of mycology. An account is given of each of the groups, and this is followed by a description of some of the more important genera. Naturally views differ as to classification. The most radical change, and one which will probably not meet with general acceptance is the exclusion of *Synchytrium*, *Woronina*, *Olpidiopsis*, *Rozella*, etc., on the ground that the production of a vegetative plasmodium is entirely foreign to the eu-mycetes, and allies these organisms to the Myxomycetes and other forms which the author follows De Bary in considering to be animals.

The groups and families in Dr. Zopf's classification are arranged as follows:

I. PHYCOMYCETES.
- 1. Chytridiaceæ.
  - (1) Olpidiaceæ.
  - (2) Rhyzidiaceæ.
  - (3) Chladochytriaceæ.
- 2. Oomycetes.
  - (1) Saprolegniaceæ.
  - (2) Ancylistieæ.
  - (3) Peronosporeæ.
- 3. Zygomycetes.
  - (1) Mucoraceæ.
  - (2) Chætocladiaceæ.
  - (3) Piptocephalideæ.
  - (4) Entomophthoreæ.

II. MYCOMYCETES.
- 1. Basidiomycetes.
  - (1) Protobasidiomycetes.
    - (*a*) Pilacreæ.
    - (*b*) Auriculariaceæ.
    - (*c*) Tremellaceæ.
    - (*d*) Dacryomycetes.
  - (2) Hymenomycetes.
    - (*a*) Hypochnaceæ.
    - (*b*) Thelephoraceæ.
    - (*c*) Clavarieæ.
    - (*d*) Hydnaceæ.
    - (*e*) Polyporaceæ.

(MYCOMYCETES—continued).
    - (*f*) Agaricaceæ.
  - (3) Gasteromycetes.
    - (*a*) Hymenogastreæ.
    - (*b*) Sclerodermieæ.
    - (*c*) Lycoperdaceæ.
    - (*d*) Nidulariaceæ.
- 2. UREDINEÆ.
- 3. USTILAGINEÆ.
- 4. ASCOMYCETES.
  - (1) Gymnoascaceæ.
    - (*a*) Saccharomycetes.
    - (*b*) Exoasceæ.
    - (*c*) Gymnoasceæ.
  - (2) Perisporiaceæ.
    - (*a*) Erysipheæ.
    - (*b*) Aspergilleæ.
    - (*c*) Tuberaceæ.
  - (3) Sphæriaceæ.
    - (*a*) Sphæriaeæ.
    - (*b*) Hypocreaeæ.
    - (*c*) Xylarieæ.
    - (*d*) Hysteriaeæ.
  - (4) Discomycetes.
    - (*a*) Pezizaceæ.
    - (*b*) Helvellaceæ.

The author differs from Brefeld in keeping Gymnoascus among the Gymnoasceæ; from Rehm in classing Hysteriaeæ under Sphæriaceæ; from Fischer and most of the recent systematists in including Plasmopara, etc., under Peronospora; and from Schröter in excluding Myxomycetes, etc., on the grounds already stated.

The appendix is devoted to an interesting account of the following fungi imperfecti:–*Torula*, *Mycoderma cerevisiæ*, *Monilia candida*, *M. albicans*, *Dematium pullulans*, *Oidium schœnleinii*, *O. quinckeanum*, *O. tonsurans*, *Hormodendron cladosporioides*, *Cladosporium herbarum*, *Septosporium bifurcum*, *Stachybotrys atra*, and *Arthrobotrys oligospora*. The book concludes with a list of errata (by no means complete), a list of illustrations, and a general index. It is printed in clear Roman type, on good paper, and except for the half-paper cover, which does not wear well, is, like most German books, well bound. The illustrations are especially praiseworthy, not so much for mechanical execution, wherein some are inferior, as for the care with which they have been selected to illustrate particular features, and the fact that most of them have not been hackneyed by repeated use in other books. The illustrations are also numerous enough, by the union of many distinct figures into one so-called figure, to give a good general notion of the whole subject of fungi.

In several cases there is an omission of important facts which should appear in a work of this charatcer, *e. g.*, Jensen hot water treatment for smut of oats and wheat, or Humphrey's discovery of cilia on the swarm spores of *Achlya*. Occasionally also there is a slip, *e. g.*, on page 90 the term "*epiplasm*" is attributed to De Bary with a different meaning from that given in his Morphologie, *i. e.*, De Bary uses it for glycogen mass, but it is here used to designate the residual protoplasm in free cell formation, for which De Bary's own term is "*periplasm*;" on pp. 386 and 397 the genus *Endophyllum* is said to possess no teleutospores, but to have æcidiospores which germinate with the formation of a promycelium and sporidia, all of which might have come from a superficial consideration of the arrangement of the spores or from a hasty reading of Winter's description (Pilze I. p. 251), but which can scarcely be admitted if we are to attach any definite meaning to the term *teleutospore*; on p. 439 *Gymnoascus reesii* is said to be the only species of the genus, whereas Winter gives 3 and Saccardo 6. Such causes for complaint are, however, comparatively few, the bulk of the errors consisting of transpositions, slight omissions, incorrect numbering of descriptions (*e. g.*, fig. 74), and wrong cross-references. Of the latter there are at least a hundred, a very considerable number for a book of reference. Happily, so far as observed, these mistakes do not extend to the index, or the references to literature which are quite copious. This book was evidently first issued as part of a larger work of some sort (*Schenck's Handbuch?*) and then repaged for issue in the present form, and the errors are probably attributable to want of care in the revision.

The treatment of the whole subject of conidia and of the special group *Saccharomycetes* is of particular interest, but to readers already familiar with De Bary, the chapters devoted to physiology and biology will no doubt seem freshest, while to the beginner the 200 pages devoted to

classification must prove invaluable and alone worth many times the price of the book. So far as known to the writer, there is no other book in any modern language in which the student just commencing the study of fungi can find so good a résumé of what is absolutely essential for him to know. If he masters this one book he will have laid an excellent foundation for future studies of special monographs, and of that vaster book never to be included in any monograph.

(2) Dr. Kirchner's book occupies an entirely different field from the preceding. The plan is also quite unlike that followed in the handbooks of Frank and Sorauer. In fact the book is unique in the literature of plant diseases. In his preface the author regrets that knowledge of plant diseases and injuries is so little diffused among practical men, the very class who need it, and ascribes this in part to the fact that their study leads at once into the most difficult departments of two sciences, botany and zoölogy, and requires more time and more special knowledge than is at their command.

By keeping constantly in view the needs of farmers and gardeners, the author has succeeded in overcoming many of the difficulties and making a very practical, useful book. Theoretical considerations and technical expressions are excluded as far as possible, and a commendable effort has been made to combine simplicity with perspicuity and accuracy. In a book of this character it is of course impossible to avoid errors, and some have crept in, but there are not enough to seriously injure its usefulness. No claim is made to completeness, but nevertheless a great amount of interesting and valuable information has been well digested and put together in a very accessible form, and the general accuracy of statement is especially commendable. It is a book to save the busy man's time by answering as quickly as possible the following questions: (1) What ails the plant? (2) How can the trouble be remedied? The author has not confined himself to prominent diseases or to those due solely to vegetable parasites, but has made a praiseworthy effort to mention all, and the reader is therefore likely to find a paragraph touching any disease or injury on which he may wish enlightenment, provided, of course, it is one that occurs in middle or northern Europe.

The book is divided into two parts, the first 368 pages being an artificial key to the diseases and injuries of agricultural plants, arranged under the following heads: Cereals 14, edible Leguminosæ 6, grasses 20+, forage plants 25+, roots 4, commercial plants 12, vegetables and kitchen plants 27, fruit trees 11, berries 6, and the vine 1—total 126. The diseases attacking these 126 plants are classified according to gross appearances and according to the parts they attack. For example, 17 pages are devoted to the diseases of *Vitis vinifera*, arranged in the following way: I. Diseases and injuries of the leaves, II. diseases and injuries of the buds and shoots, III. diseases and injuries of the branches, IV. diseases and injuries of the old wood, V. diseases

and injuries of the roots, VI. diseases and injuries of the flowers and flower buds, VII. diseases and injuries of the berries. Under each of these groups are as many lettered or numbered divisions and subdivisions as may be necessary to include all of the diseases, one paragraph being given to each, with a numeral cross-reference to Part II, where a scientific description of the parasite may be found. When possible, classification is carried still farther, *e. g.*, under VII. diseases and injuries of the berries, the following subdivisions are given:

A. Rot of the berries.
    a–e.—Five paragraphs devoted to as many diseases.
B. Spots which hinder development, and sometimes completely destroy the berry, caused by fungi, which also occur on the leaves.
    a–g.—Seven paragraphs.
C. Spots of varied color which do not noticeably affect the growth and ripening of the berries.
    a–d.—Four paragraphs.
D. Injuries by insects.
    a–d.—Four paragraphs.
E. Dwarfing, protrusion of seeds, etc.

In Part II, under the appropriate classes, groups, orders, and families, there is a concise description of 1,332 injurious species, 423 of which are parasitic plants, mostly fungi, the descriptions of which are drawn principally from Saccardo, Winter, and Schröter. These 1,332 species are numbered serially, corresponding to the cross-references in Part I. A concise account is also given of the classes, orders, families, and genera to which these species belong, so that this part of the book is really a very serviceable compendium of parasitic plants and animals.

On the whole, this is the best book extant for the rapid determination of unknown plant diseases, and will therefore be of much use to students. The book would have had a wider circle of readers and have been still more useful if the author had included shade trees and all cultivated plants. Notes on treatment are given wherever anything definite has been ascertained, but this is the weakest part. The book is provided with a table of contents, an index to names, and a special index to technical terms.—ERWIN F. SMITH.

RUST IN WHEAT.—Report of the proceedings of the conference, convened by invitation of the Minister for Agriculture (the Hon. Sidney Smith), and held in Sydney [New South Wales] on June 2, 3, 4, 5, and 8, 1891. Sydney, Charles Potter, government printer, 1891. Folio, pp. 56, pl. 1.

The subject of rust in wheat has of late years excited the liveliest interest in the Australian colonies. According to a statement of the Minister for Agriculture, the total loss from the disease amounts to about £2,000,000 annually, and naturally a desire is felt to find some way of combating it. During the year 1890 many experiments were carried on. Details of these are given in the report of the conference convened at Sydney in June, 1891, at which delegates from the four

colonies, Victoria, South Australia, Queensland, and New South Wales, were present.

The subject was discussed in all its phases, but it is neither possible nor desirable to enter fully into all the details. In Victoria the effects of manuring, spraying, drainage, varieties of seed, etc., were all tried. The results were largely negative, except in one instance, in Gippsland, where spraying with a solution of sulphate of iron, 1 ounce to 1 gallon of water, seemed to not only prevent but to stop further growth of the rust. More experiments are considered necessary in this direction, however. A series of questions was also sent out to farmers in Victoria and the results of the answers may be summarized as follows: (1) Rust seldom appears, to an injurious extent, in two successive years; (2) it generally appears early in October or November, depending upon the variety planted; (3) early-sown and early-maturing varieties escape the rust best; (4) in Australia the rust does not seem to require a change of host, but passes its entire existence upon a single one; (5) rust seems to prevail usually in seasons of excessive rainfall, especially in October and November, appearing when close and muggy weather sets in; its spread is most rapid in calm, hot days and dewy, foggy nights; windy weather as a rule is unfavorable; (6) the kind of soil seems to have no effect on the disease; (7) rust-shriveled wheat when sown appears to produce as good a crop and one as free from rust as plump seed; (8) no variety is free from rust in a bad season, but some are more and others are less affected, some few being free from rust for several years in succession.

The following suggestions are made as to the best measures to lessen or prevent damage: (1) Maintain a high standard of health; (2) use all possible measures unfavorable to and avoid those favorable to rust; (3) remove exciting causes where possible, by burning stubble, destroying weeds, etc.; (4) obtain as far as practicable rust-proof varieties; (5) spray crop with some solution at critical stage.

Experiments in Queensland reported on by Mr. P. McLean were mainly negative, owing to the exceptionally favorable year. Rust-shriveled seed wheat, however, was found by fifty-five out of sixty farmers to give good results.

Answers to inquiries made by the Department of Agriculture of New South Wales did not differ materially from those already given. At the conclusion of the report, however, the writer, Dr. N. A. Cobb, referred to investigations he had made on the fungi causing rusts (*Puccinia rubigo-vera* and *P. graminis*), stating that nearly all the damage was caused by the former. He described the changes these fungi undergo in development, and said they are found all the year on either wheat or native grasses. He also called attention to the fact that the larvæ of a species of insect had been found feeding upon the rust spores, and that while in this way a certain number of spores were destroyed they were also widely distributed by adhering to hairs

covering the bodies of the insects. For prevention of the rust early sowing was advocated, and the belief was expressed that saccharate of copper would be useful in spraying for the disease.

This paper led to considerable discussion, especially in regard to the benefits of spraying. The general idea, however, was that if practicable this would be the best way of combating the disease. There was also considerable discussion over the matter of producing a rust-resisting variety of wheat, advocated by Wm. Farrer of New South Wales. Other reports were read and the conference finally submitted a report containing numerous recommendations. Among these were early sowing, cutting in the dough state except when to be used for seed, experimenting to obtain rust-proof varieties, the establishment of stations to distribute standard and desirable varieties, more extended use of red varieties in place of the white ones, rotation of crops, thin sowing, burning of diseased straw, experiments with spraying machines and fungicides, etc.

Incidentally, the disease known as "take-all" was discussed, the investigations of a commission of South Australia, in 1867 and 1868, being cited to prove that it is due to the presence of a minute animalcule which was called *Vibrio tritici* or eel of wheat. These animalculæ are harbored in a black deposit, a "lichen or moss," found between the roots and the first internode of the wheat plant. The disease works in patches, radiating in all directions from a center and destroys all cereals or native grasses in its course.

The conference, as a whole, may be regarded as a success. Views of diverse character were expressed by the delegates, and it is of course possible that what would apply in one colony would not in a distant one. Should the conference be instrumental in directing attention to methods for decreasing the amount of rust, and there is every reason for supposing that it will, its meeting will not have been in vain.—JOSEPH F. JAMES.

ERRATA TO INDEX TO LITERATURE.

The following numbers were purposely omitted from the last number of the JOURNAL: 395, 401, 532, 537, 538, 547, 640, and 651.

The following corrections and additions should be made in the numbers of the INDEX:

No. 10. *Add* (see also Ex. Sta. Rec., Vol. II, April, 1891, pp. 481–482).
No. 34. *Add* (see also Ex. Sta. Rec., Vol. II, Sept., 1890, p. 49).
No. 40. *Add* (see also No. 104, and Ex. Sta. Rec., Vol. II, Sept., 1890, p. 63).
Nos. 42, 43. *Add* (see also Ex. Sta. Rec., Vol. II, Oct., 1890, p. 134).
No. 51. *Add* (see also Ex. Sta. Rec., Vol. III, Dec., 1891, p. 297).
No. 69. *Add* (see also Ex. Sta. Rec., Vol. II, Oct., 1890, pp. 104–105).
No. 73. July 21 *should be* July 2.
No. 105. *Add* (see also Ex. Sta. Rec., Vol. II, Aug., 1890, pp. 12–13).
No. 113. *Add* (see also Ex. Sta. Rec., Vol. II, Feb., 1891, p. 325).
No. 116. *Add* (see also Ex. Sta. Rec., Vol. II, Dec., 1890, p. 246).
No. 123. *Add* (see also Ex. Sta. Rec., Vol. II, July, 1891, pp. 713–716).
No. 135. *Add* (see also Ex. Sta. Rec., Vol. II, Dec., 1890, pp. 241–242).
No. 140. P. 141 *should be* p. 481.
No. 150. *Add* (see also Ex. Sta. Rec., Vol. II, Dec., 1890, p. 252).
No. 156. *Add* (see also Ex. Sta. Rec., Vol II, Feb.,1891, pp. 342–343).
No. 157. *Add* (see also Ex. Sta. Rec., Vol. II, Dec., 1890, pp. 220–222).
No. 179. *Add* (see also Ex. Sta. Rec., Vol. II, April, 1891, pp. 508–509).
No. 192. *Add* (see also Ex. Sta. Rec., Vol. II, April, 1891, pp. 504–505).
No. 197. *Add* (see also Ex. Sta. Rec., Vol. II, March, 1891, p. 406).
No. 199. *Add* (see also Ex. Sta. Rec., Vol. II, March, 1891, pp. 416–417),
No. 209. *Add* (see also Ex. Sta. Rec., Vol. II, March, 1891, pp. 421–423).
No. 215. *Add* (see also Ex. Sta. Rec., Vol. II, March, 1891, pp. 408–410).
No. 238. *Add* (see also Ex. Sta. Rec., Vol. II, April, 1891, p. 490).
No. 241. *Add* (see also Ex. Sta. Rec., Vol. II, Jan., 1891, pp. 293–294).
No. 245. *Add* (see also Ex. Sta. Rec., Vol. II, June, 1891, pp. 637–638).
No. 246*a*. *Add* (see also Ex. Sta. Rec., Vol. III, Aug., 1891, pp. 7–8).
No. 254. *Add* (see also Ex. Sta. Rec., Vol. II, Aug., 1890, p. 25).
No. 270. *Add* (see also Ex. Sta. Rec., Vol. II, April, 1891, p. 501).
Nos. 276 to 287, inclusive. *Add* (see also Ex. Sta. Rec., Vol. III, Oct., 1891, pp. 160–161).
No. 291. *Add* (see also Ex. Sta. Rec., Vol. II, June, 1891, pp. 638–641).
No. 295. *Should read* McC[arthy], G[érald]. Also pp. 156–158 *should be* 155–156.
No. 310. *Add* (see also Ex. Sta. Rec., Vol. II, July, 1891, pp. 711–712).
Nos. 311 to 326, inclusive. *Add* (see also Ex. Sta. Rec., Vol. III, Aug., 1891, pp. 9–11).
No. 327. *Add* (see also Ex. Sta. Rec., Vol. II, May, 1891, p. 606).
No. 329. This is the same article as No. 176.
No. 353. *Add* (see also Ex. Sta. Rec., Vol. II, July, 1891, pp. 749–750).
No. 460. The date *should be* Nov. 7.
No. 476. P. 524 *should be* p. 525.
No. 477. *Add* (see also Ex. Sta. Rec., Vol. III, Nov., 1891, p. 243).
No. 481. *Add* (see also Ex. Sta. Rec., Vol. III, Sept., 1891, p. 101).

No. 483. *Add* (see also Ex. Sta. Rec., Vol. III, Nov., 1891, pp. 225-227).
No. 484. *Add* (see also Ex. Sta. Rec., Vol. III, Dec., 1891, pp. 285-286).
No. 485. *Add* (see also Ex. Sta. Rec., Vol. III, Dec., 1891, p. 287).
No. 486. *Add* (see also Ex. Sta. Rec., Vol. III, Dec., 1891, p. 286).
No. 487. *Add* (see also Ex. Sta. Rec., Vol. III, Dec., 1891, p. 286).
No. 490. *Instead of* [? MASTERS, M. T.] *read* SMYTHE, ——).
No. 509. *Add* (see also Ex. Sta. Rec., Vol. III, Nov., 1891, p. 217.)
No. 514. Oct. 23 *should be* Oct. 31.
No. 515. *Add* (see Agric. Science, Vol. V, Dec., 1891, pp. 282-283, for abstract).
No. 590. *Instead of* [? MASTERS, M. T.] *read* [WAITE, C. J.].
No. 609. *Add* (see also Am. Gardening, Vol. XIV, April, 1892, p. 248, 1 col.; Phar. Jour. and Trans., Vol. LI, London, Jan. 9, 1892, p. 558; Jour. Soc. Arts., Lond., Jan. 1, 1892).
No. 619. Fig. 4 *should be* Fig. 5.
Nos. 632, 633. *Add* (see also Ex. Sta. Rec., Vol. III, Nov., 1891, p. 217).

INDEX TO LITERATURE.

In the following index all articles from foreign sources are indicated by the numbers prefixed being in bold-faced type. All those having numbers with the ordinary type relate to American literature.

A.—WORKS OF A GENERAL NATURE.

654. [ANON.] **Bovine actinomycosis or "lump jaw."** <Am. Agric., vol. L, New York, Jan., 1891, p. 52, fig. 5.

Gives brief historical notes on the disease and describes its character. Due to a fungus. Notes mode of infection, treatment etc. (J. F. J.)

655. [ANON.] **The late F. W. Anderson.** <Am. Agric., vol. LI, New York, Feb., 1892, p. 152, 1 col., port.

Sketch of the life of F. W. Anderson, formerly connected with the Department of Agriculture and later associate editor of the American Agriculturist. (J. F. J.)

656. BIZZOZERO, CARUEL, GIBELLI, PASSERINI, FRINCHESE E TODARO. **Relazione sul concorso al premio Reale per la Morfologia normale e patologica, per l'anno, 1888.** <Atti reale Accad. Lincei, Anno 288, ser. 4, vol. VII, Rome, 7 giugno 1891, pp. 532–543.

Gives discussion of volumes 4–7 of Saccardo's Sylloge Fungorum Omnium, with regard to its claim for the royal prize. Decided to give half the prize to Saccardo and the other half to G. B. Grassi, a zoölogist. (W. T. S.)

657. [EDITORIAL]. **Fungus-eating.** <Nature, vol. XLV, London, Nov. 26, 1891, pp. 75–76.

A notice of M. C. Cooke's "British Edible Fungi," giving a statement of its general scope. Notes that 200 species of British fungi are edible and about 50 of these are considered as dainties. A paragraph is quoted to the effect that no general rules are to be laid down to distinguish edible from poisonous species. (J. F. J.)

658. FAIRCHILD, D. G. **Index to North American mycological literature.** <Jour. of Mycol., vol. VI, Washington, May 14, 1890, pp. 42–44; Sept. 10, 1890, pp. 80–87; Jan. 6, 1891, pp. 128–135; April 30, 1891, pp. 184–191; vol. VII, Sept. 10, 1891, pp. 52–63.

A list, by authors, of papers relating to mycological literature, with brief notes on contents, beginning with January 1, 1890. Now merged in the present index. (J. F. J.)

659. GALLOWAY, B. T. **The work of the United States Department of Agriculture, especially in its relation to plant diseases and injuries to crops through unfavorable weather conditions.** <Hartford Times, Conn., Jan. 27, 1892.

Abstract of a paper read before the Pomological Society of Connecticut, giving an outline of the work of the Department. Various plant diseases discussed and general reference made to value of predictions of frosts by Weather Bureau. (J. F. J.)

660. HALSTED, B. D. **Botany at the Washington meetings.** <Am. Nat., vol. XXV, Phila., Oct., 1891, pp. 914–916.

Mentions the papers, with brief note of contents, read before various societies in Washington, D. C., from August 12 to 29. Many of the papers treated of fungi, of diseases of plants, or of preventives for disease. (J. F. J.)

661. POPE, FRANK M. **Micro-organisms in their relations to the higher animals.** <Trans. Leicester Lit. and Phil. Soc., new ser., vol. II, Leicester Jan., 1891, pp. 256–262.

Gives brief account of history of micro-organisms. Mentions divisions of fungi as (1) Mold fungi; (2) Mycetoza; (3) Yeast fungi, and (4) Fission fungi. Gives brief account of each class giving De Bary's classification of parasitic fungi as obligatory parasites, facultative parasites, and obligatory saprophytes. Notes the presence of mold fungi as more common in plants than animals, but mentions in the latter *Empusa*, *Laboulbenia*, and *Saprolegnia*. **Describes effects of bacteria on animal organisms.** (J. F. J.)

662. SORAUER, PAUL. **Das phytopathologische Laboratorium zu Paris.** <Zeitsch. für Pflanzenkrankheiten, vol. I, Stuttgart, 1891, p. 51.

Notices the establishment of a laboratory for the study of plant diseases at Paris by order of the Minister of Agriculture on August 24, 1888. Prillieux is director, Delacroix assistant in laboratory work. The laboratory is at 16 Rue Gay-Lussac, in Paris. (W. T. S.)

663. SORAUER, PAUL. **Der Antrag Schulz-Lupitz im preuss. Abgeordnetenhause betreffend die Errichtung einer Versuchsanstalt für Pflanzenschutz.** <Zeitsch. für Pflanzenkrankheiten, vol. I, Stuttgart, 1891, pp. 54–62.

Gives synopsis of a stenographic report of a speech of Schulz-Lupitz in the Prussian Chamber of Deputies, favoring the establishment of a central station for the study of plant diseases. Sorauer opposes this plan, and thinks it better to establish a number of scattered independent stations, giving as reasons that the study can be best carried out in the place where the disease occurs and by investigators familiar with local conditions; that it is difficult to obtain necessary appliances in case an investigator is sent from a central station to the center of disease; that it promotes scientific progress to have investigators free and not under a single head as at a central station, and that local diseases can be recognized and stopped before they attain sufficient importance to demand attention from a central station. (W. T. S.)

664. WARD, MARSHALL. **Two lectures on "Parasitic plants, native and exotic."** <Quar. Rec. Roy. Bot. Soc. London, vol. IV, Lond., April, May, June, 1891, pp. 150–153.

In the second lecture notes are given on parasitic fungi. One attacking *Vaccinium* and one the lily are especially noted. (J. F. J.)

(See also, Nos. 869, 880.)

B.—DISEASES OF NONPARASITIC OR UNCERTAIN ORIGIN.

665. [ANON.] **Cure for the yellows.** <Popular Gardening, vol. VI, Buffalo, Sept., 1891, p. 251.

Notes discussion in regard to disease in a meeting of the Conn. State Board of Agriculture, between Hale and Meech. Former claims pruning and muriate of potash can cure it; Meech claims not. (D. G. F.)

666. [ANON.] **Dreading peach yellows.** <Am. Gardening, vol. XIII, New York, Feb., 1892, p. 128, $\frac{1}{3}$ col.

Quotes from circular of horticultural commissioners of Yuba County, Cal., advising against importation of trees from outside the State. (J. F. J.)

667. [ANON.] **Mysterious vine disease.** <Rural Californian, vol. XV, Los Angeles, Mar., 1892, p. 129, $\frac{1}{3}$ col.

Refers to work of N. B. Pierce on the disease, noting the necessity of using cuttings from healthy vines, and from regions outside locality where the disease exists. (J. F. J.) (See also Cal. Fruit Grower, etc., San Francisco, vol. X, Mar. 5, 1892, p. 154.)

668. [ANON.] **[Take all.]** <Agric. Gaz. N. S. Wales, vol. II, Sydney, Sept., 1891, pp. 556–557.

Mentions a disease of wheat which is often spoken of at farmers' meetings and in the press. A number of specimens were examined, but no conclusion was reached. (M. V.)

669. [ANON.] **The issue on peach yellows.** <Pacific Rural Press, vol. XLIII, San Francisco, Jan. 16, 1890, p. 52.

Editorial on the exclusion of eastern-grown peach trees; shows that exclusion of all eastern trees is absolutely necessary to keep out yellows. Notes are given from Bulletin No. 1, of the Division of Vegetable Pathology, in regard to the communicability of yellows. (B. T. G.)

670. [ANON.] **The peach yellows.** <Cult. and Country Gent., vol. LVI, Albany, Nov. 19, 1891, p. 436, $\frac{1}{2}$ col.

Refers to yellows being transferred from diseased to healthy trees by pruning knife. Disease is sometimes mild, frequently virulent. Cases mentioned where it appeared in trees widely separated. Only remedy so far known is cutting out and burning. (J. F. J.)

671. DODGE, G. M. **Root knot on apple trees.** <Insect Life, vol. II, Washington, April, 1890, p. 315.

Mentions occurrence of knots on roots of apple trees supposed to have come from Kansas. May and may not have been caused by a nematode. (J. F. J.)

672. [EDITORIAL.] **The peach yellows.** <Rural Californian, vol. XV, Los Angeles, Mar., 1892, p. 142, 1 col.

Quotes opinion of Meehan that yellows is caused by *Agaricus melleus*. Argues against the idea and states that the climate of parts of California is certainly favorable for the growth of Agaricus and fruit-growers should be careful about the importation of trees. (J. F. J.)

673. [EDITORIAL.] **The two puzzles. Pear blight.** <Cult. and Country Gent., 61st year, Albany, Dec. 3, 1891, p. 976, ½ col.

Refers to peach yellows and pear blight and concludes only method of eradication is to cut off and burn diseased parts. Mentions cutting out of diseased wood of pears and advantage resulting from better cultivation of remainder of orchard in producing better fruit. (J. F. J.)

674. [GOETHE, R.] **Einige Ursachen durftigen Wachsthums der Obstbäume.** <Ber. K. Lehranst. für Obst- und Weinbau zu Geisenheim am Rhein, für d. Etatsjahr 1889–90, Wiesbaden, 1891, pp. 38–40, fig. 1.

As a cause of stunted growth of young nursery trees gives the differences existing between stock and scion. Recommends selection of seed for stocks from vigorous parents and the rejection of all stunted stocks. A common cause of stunted growth is too deep planting. Such deeply set trees are not only stunted, but were liable to diseases and to attacks of insects. Mentions that deep-set trees are more likely to have "Krebs" or in case of stone fruits "gummosis." Such plants also suffer first from frost. Even if planted only 5 cm. too deep the tree suffers. One may suppose the injurious effects of deep planting are due to the injurious effects of the soil moisture on the bark of the buried portion, or that they are due to the hindering of respiration of this portion of the bark, causing stagnation of the sap. One thing is certain, the flow of sap is hindered through the buried stem and causes the production of watersprouts and roots here. Lack of moisture may also be the cause of the trouble. (W. T. S.)

675. "INDIGATOR." **Die-back.** <Fla. Disp., Farmer and Fruit Grower, new ser., vol. III, Jacksonville, Jan. 29, 1891, p. 85.

Gives analyses of soil upon which die-back of orange does and does not exist, showing that soil where it exists has more organic matter and more phosphoric acid than the one on which it is not known. (D. G. F.)

676. JÖNSSON, BENGT. **Om brannfläckar på växtblad.** <Bot. Notiser, Lund, 1891, pp. 1–16, 49–62, pl. 2.

Burnt spots on leaves of plants, which are kept in green or hot houses, have been recorded in the oldest phytopathological literature. Several theories have been given to explain their origin, and the author shows by experiments that the oldest theory, that the burnt spots are caused by the action of the sun's rays through air-bubbles in the glass, is entirely correct. Among the different theories, enumerated and discussed by the author, the following might be mentioned; De Candolle (Physiologie végétale, III, p. 1113) thought that the water might soften the tissue of the leaves and then by being heated in the sun prevent the evaporation and produce burnt spots. Sorauer (Pflanzenkrankheiten, 2nd ed., I, p. 456) says that when drops of water are left upon leaves of plants in hothouses without draught and exposed to the sun, they cause burnt spots. Other authors, Neumann (Adansonia, vol. II, 1862) and Frank in part (Die Krankheit. d. Pflanzen, 1880, p. 174) believed that the drops of water merely by their own heat could produce the burning, but Frank was not unwilling to suppose that the drops might also have the same effect as lenses. Hoffmann (Samenbruch bei der Weinbeere, Bot. Ztg., 1872, p. 113) had observed that grapes upon which drops of water had been left became burnt, and he thought that the drops had really acted as lenses, concentrated the sunlight and produced the burning, and this theory has also been given by Von Thümen (Ueber den Sonnebrand der Rebenblätter, Die Weinlaube, 1886 pp. 409–410). The author has now examined these different theories and he has proved that drops, fallen upon leaves, are unable to burn, since they represent but half a lens, and they are not able to burn by their own heat, since this is far from being strong enough to disturb the tissues. The only acceptable explanation is that poor glass with air bubbles produces the burning, although he is not quite unwilling to see some cause in drops of water which are hanging down from the inside of the glass. (Theo. Holm.) (See Bot. Gaz., vol. XVII, Mar. 17, 1892, pp. 89–91.)

677. MAY, WALTER. **Die Rohrzucker-Culturen auf Java und ihre Gefährdung durch die Sereh-Krankheit.** <Bot. Zeit. 49 Jahrg. Leipzig, Jan. 2, 1891, pp. 10-15.

After giving a general account of the soil and climatic conditions in Java in reference to the culture of sugar cane, the author describes the Sereh-disease. It appeared in Java in 1879–1880 but did not cause much damage until five years later, when it spread rapidly over almost the entire island, causing immense loss. Since then the disease has prevailed to greater or lesser extent every year. The outer symptoms of the disease are given thus: The stems remain short, the leaves are crowded, many branches and aërial roots are produced; the diseased plants do not develop a tall upright stem, but form a small fan-shaped tuft of leaves. In the worst cases no cane is produced, only leaves; certain tissues of the diseased plants become reddened, and cuttings taken from such plants show an increased redness and finally decay. The checked growth of the diseased plants brings about a diminished sugar content and the sugar present is difficult to secure. As to the cause of the disease no generally accepted explanation has been put forth. Nematodes, bacteria and even methods of culture newly introduced have been supposed by different writers to be the cause. The best means of combating the malady at present known is to obtain sets from Sereh-free regions such as Borneo. (W. T. S.)

678. MCCALLAN, C. W. [and HOWARD, L. O.]. **The Bermuda peach maggot and orange rust.** <Insect Life, vol. III, Washington, Nov., 1890, pp. 120–121.

Describes disease of oranges. Trees die from limb to limb in one year. New shoots also die rapidly and in three or four years the tree is entirely dead. This is said to be die-back. Disease yields to treatment with carbolic or creosote washes "provided the existing cause is removed, and this latter is variously ascribed to over-fertilization, deep planting and imperfect drainage." (J. F. J.)

679. [MEEHAN, T.] **Peach yellows.** <Meehan's Monthly, vol. I, Germantown, Pa., Oct. 1891, p. 55, ⅓ col.

Considers disease due to *Agaricus melleus*. (J. F. J.)

680. [MEEHAN, T.] **Peach yellows.** <Meehan's Monthly, vol. II, Germantown, Pa., Feb. 1892, p. 27, ½ col.

Refers to fears of spread of peach yellows in California. Considers disease due to *Agaricus melleus*. "We would just as soon expect to hear of the peach yellows in California as we would to hear of an acre of pineapples being produced in Maine." (J. F. J.)

681. RÁTHAY, EMERICH. **Ueber eine merkwürdige durch den Blitz an Vitis vinifera hervorgerufene Erscheinung.** <Denkschr. d. math. naturw. Classe d. K. Akad. d. Wissensch. Bd. LVIII, Wien, 1891, pp. 26, pl. I–II.

An interesting and exhaustive paper on the remarkable effects produced by lightning on *Vitis vinifera*. The author discusses the autumnal coloration of grape foliage, the coloration as a result of mechanical injuries to the leaf veins, the petioles and shoots, coloration due to lightning and various questions concerning the effects of lightning on vines grown under glass. The paper concludes with the following summary:

(1) According to observations hitherto made, lightning in graperies, as in herds of sheep, does not single out individuals but strikes large numbers; (2) the tips of shoots struck by lightning die, while the parts lower down survive, at least for some time; (3) the assertion of Colladon's, which is doubted by Caspary, that the foliage of the vine is reddened by the effects of lightning, is correct in regard to all vines whose foliage shows red coloration in the fall; (4) the latter is peculiar to *Vitis sylvestris*, is furthermore to all purple and certain red varieties of *Vitis vinifera* and finally to certain, but by no means all purple, varieties of American vines; (5) vines that redden in the autumn also do so as a result of mechanical injuries to the leaf-nerves, petioles, and stems. Girdling, bending, and partial severing of the latter, produces a red discoloration of all leaves above the injured parts; (6) the reddening of vine leaves after receiving mechanical injuries is not conditioned by a diminished transportation of water; (7) vine leaves, that assume a red color as a result of mechanical injuries, transpire much less than green leaves; (8) the red coloration of vine leaves caused by lightning, resembles in every respect that occurring as the result of mechanical injuries; (9) the change in color is only an indirect result of lightning caused by the latter killing the tissue found on the outside of the cambium in the middle pieces of numerous successive internodes, which corresponds to a repeated girdling; (10) the cambium of the shoots affected by lightning continues to live and produces, in an outward direction, a callus within the deadened tissues, surrounded with cork, while in an inner direction it produces a ring of wood, which is separated from the older wood by a thin brown layer; (11) according to the observations of many, the berries struck by lightning dry up completely. (B. T. G.)

682. SAHUT, FÉLIX. **Les végétaux considérés comme des thermomètres enregistreurs.** <Ann. Soc. d'hort. et d'hist. nat. de l'Hérault, 2 sér. tome XXIII, Montpellier, May, June, 1891, pp. 158–178.

Discusses the effect of cold on introduced plants from observations made in southern France during a period of more than thirty years. The conclusions are as follows: (1) All other conditions being the same, individuals whose wood is well ripened will resist cold more than those whose wood is not well ripened. Individuals of some tender species will be affected more or less by the same degree of cold according as they are in a more or less active state of vegetation. (2) Given a specific fall of temperature, plants, for the most part at least, will be much more seriously affected if the air be moist than if it be dry. (3) With equal temperatures, other conditions remaining the same, the effects of cold will be more destructive if the trees and plants be violently shaken by the wind at the time of a great fall of temperature. Plants which will resist 12° in still air may freeze at 8° in windy weather. (4) The effects of a given lowering of temperature will be destructive in proportion to the persistence of the cold. (5) The resistance to cold of a woody plant increases in proportion to its arborescence. (6) In like conditions, also, a sickly plant will be more sensitive to cold than a healthy one. Chlorotic vines, for instance, are much more subject to cold than healthy ones placed side by side. (7) Observations must not be confined to a single individual. In different individuals of every species the resistance to cold varies appreciably. The author believes it is possible by an intelligent selection carried on for a number of generations to create in many species of plants races less tender than those we are familar with. (E. F. S.)

683. SMITH, ERWIN F. **The peach rosette.** <Jour. Mycol., vol. VI, Washington, April 30, 1891, pp. 143–148, pl. VIII–XIII.

Describes a disease similar in its appearance and effects to peach yellows, mentioning points of resemblance and difference. Occurs in Georgia and Kansas. Does not consider it due to attacks of insects, as has been supposed. The disease is contagious, and affected trees should be dug out and burned. (J. F. J.)

684. SMITH, ERWIN F. **What to do for peach yellows.** <Jour. Mycol., vol. VI, Washington, Mar., 1890, pp. 15–16.

Mentions experiments made with fertilizers, which do not warrant recommending any special treatment. Only plan suggested is to dig out and burn affected trees. (J. F. J.)

685. "VIOLET." **The violet disease.** <Am. Florist, vol. VI, Chicago and N. Y., Feb. 18, 1892, p. 590, 1 col., fig. 1.

Gives experience in raising violets and says, "keep the cold water off your violet foliage and you will have no disease." (J. F. J.)

686. VÖCHTING, HERMANN. **Uber die Abhängigkeit des Laubblattes von seiner Assimilations-Thätigkeit.** <Bot. Zeit., 49 Jahrg., Leipzig, Feb. 20, 1891, pp. 113–125. Feb. 27, 129–143, pl. 1, (III.)

Experimented with *Mimosa pudica*, *Solanum tuberosum*, *Tropæolum lobbianum*, *Dolichospermum halicacabum*, and an ornamental cucurbit. In all cases a part of the stem was placed in a space containing air free from CO_2 and exposed as usual to the sun. In every case old leaves already formed when introduced into CO_2-free air turned yellow, and in many cases fell off. The young leaves formed in CO_2-free air showed abnormal shape, size, and color, but differed from etiolated leaves. Such leaves did not recover when the plant was placed in normal atmosphere again. Shows plainly that leaves are dependent on their own assimilation for growth beyond a certain stage of development, and also that they must assimilate to support themselves when fully grown. (W. T. S.)

687. WADSWORTH, C. D. **Is the violet disease a myth?** <Amer. Florist, vol. VII, Chicago and N. Y., Dec. 31, 1891, p. 443, ½ col.

Gives experience with violets and believes the so-called disease is due entirely to "wrong treatment, or some parasite, insect, or something of that nature attacking the plants." (J. F. J.)

688. WADSWORTH, C. D. **The violet disease.** <Am. Florist, vol. VII, Chicago and N. Y., Feb. 25, 1892, p. 624, ⅓ col.

States failure to grow violets and concludes it to be due to the soil used. (J. F. J.)

(See also Nos. 739, 752, 758, 759, 766, 774, 775, 777, and 781.)

C.—DISEASES DUE TO FUNGI, BACTERIA, AND MYXOMYCETES.

I.—RELATIONS OF HOST AND PARASITE.

689. ARCANGELI, G. **Sopra i tubercoli radicale delle leguminose.** <Atti reale Accad. Lincei Anno 288, ser. 4, vol. VII, Rome, Mar. 15, 1891, pp. 223–227.

Review of recent work on root tubercles of Leguminosæ. Says Woronin did not discover bacteria in the tubercles, but instead Gasparrini, who published in 1851 in Atti acad. sc. d. Napoli, t. VI, as was recently noted by Pirotta. (W. T. S.)

690. DARMSTÆDTER, LUDWIG. **Der Schutz der Pflanzen und Thiere durch Wachse und Fette.** <Prometheus, Jahr. II., vol. XXXVI, Berlin, 1891, pp. 572-574.

Looks upon wax forming the bloom in many plants and a thick coating in some, as a protection against parasites. The wax is not glycerine-ether but combinations of fatty acids with higher fatty alcohols. (W. T. S.)

691. KIONKA, H. **Die Wurzelknöllchen der Leguminosen zusammenfassender Bericht über die Gesammte diesbezügliche Litteratur mit besonderer Berücksichtigung der neueren.** <Biol. Centralbl. Bd. XI, Leipzig, June 1891, pp. 282-291.

A good resumé of recent work on the subject of root tubercles of Leguminosæ. (W. T. S.)

692. MAGNIN, ANT. **Sur quelques effects du parasitisme chez les vegetaux.** <Comp. rend. Acad. d. Sci., vol. CXIII, Paris, Nov. 30, 1891, pp. 784–786.

In reply to criticisms by M. Vuillemin, M. Magnin explains that in speaking of the smutted flowers of *Lychnis dioica*, he used the term hermaphrodite in a morphological rather than physiological sense. The anthers are not filled with pollen grains but always with spores of *Ustilago*. Some additional facts confirm M. Vuillemin's observations: (1) The possibility of local infection, suspected by M. Rose and verified by M. Vuillemin, must also be admitted for *Euphorbia cyparissias* and *E. verrucosa*, emasculated by *Uromyces pisi* and *U. scutellatus*; (2) as in case of *L. dioica*, the parasite which causes stamens to appear in the neuter flowers in *Muscari comosum* only increases the size of organs which exist already in a more or less atrophied form in the neutral flowers of healthy plants; (3) ovaries have never been observed in the smutted staminate flowers of *Lychnis vespertina* or *Muscari comosum*, and this is another proof that whenever such changes take place the rudiments of the organs must have been present. The smut exerts a remarkable indirect effect on the peduncles of the staminate flowers in *Lychnis*. In the healthy staminate plant the flower falls early and the peduncle quickly dries. On the contrary in the pistillate plant the peduncle persists until after the dissemination of the seeds. Now, in parasitized staminate flowers the peduncle also persists quite a long time after anthesis, simulating the pistillate flowers. (E. F. S.)

693. [MEEHAN, T.] **Bacteria and plant diseases.** <Meehan's Monthly, vol. II, Germantown, Pa., Jan., 1892, p. 8, ⅛ col.

Notes general belief that bacteria are sole cause of disease. This has not been demonstrated. Believes they may hasten disease in plants while not causing it. (J. F. J.)

694. TAYLOR, JOHN. **Grafting reputed blight-proof apples on blighty stocks.** <Agric. Gaz. N. S. Wales, vol. II, April, 1891, p. 224.

Mentions successful experiment made in grafting reputed blight-proof apples on "blighty" stocks. (M. V.)

(See also Nos. 711, 807, 855, 871, 873, 894, and 981.)

II.—DISEASES OF FIELD AND GARDEN CROPS.

695. [ANON.] **Botany.** <Univer. Rec., Univ. of Michigan, vol. 1, Ann Arbor, April, 1891, pp. 16–17.

Notices laboratory studies of A. C. Eyclesbymer, upon club root (*Plasmodiophora brassicāe*) of cruciferous plants, and of W. H. Rush on *Peronospora gangliformis.* (See Nos. 885, and 377.) (D. G. F.)

696. [ANON.] **Peronospora hyoscyami.** <Wiener illust. Gart.-Zeit., 16 Jahrg., Wien, März, 1891, p. 130.

Short notice stating that *Peronospora hyoscyami* is found in Europe almost exclusively on *Hyoscyamus*, but news is received from Australia that it is doing great damage to tobacco. Bordeaux mixture is recommended as a preventive measure. (W. T. S.)

697. [ANON.] **Rust in wheat conference.** <Agric. Gaz. N. S. Wales, vol. II, Sydney, July, 1891, pp. 403–406.

Gives many recommendations for the immediate attention of the farmer, as for example, general experience shows that early sown wheat frequently escapes rust when late does not. (M. V.) (See also Agric. Jour. Cape Colony, vol. v, June 2, 1892, pp. 44–45: this JOURNAL, pp. 287–289.)

698. [ANON.] **Smut in wheat.** <Bull. No. 32, Dept. Agric. & Immigration, Winnipeg, Feb. 25, 1892, pp. 8.

Notes two kinds of smut in wheat, loose or black smut and bunt or stinking smut. Describes the two diseases and their reproduction. Under head of "treatment" suggests use of sulphate of copper (1 pound to 8 quarts of water for 8 bushels of seed): spread on floor and sprinkle with solution and then sift on dry lime to hasten drying. Seed may also be treated in a vat. (J. F. J.)

699. ATKINSON, G. F. **A new root-rot disease of cotton.** <Insect Life, vol. III, Washington, Mar., 1891, pp. 262–264.

Describes a disease due to a species of Nematode worm, *Heterodera radicicola.* The external characters are similar to those caused by the fungus *Ozonium.* (J. F. J.)

700. ATKINSON, GEO. F. **Anthracnose of cotton.** <Jour. Mycol., vol. VI, Washington, April 30, 1891, pp. 173–178, pl. XVII, XVIII.

Gives detailed description of fungus causing the disease (*Colletotrichum gossypii* Southw.) (See No. 732). (J. F. J.)

701. BARCLAY, A. **Rust and mildew in India.** <Jour. Bot., vol. XXX, London, Jan. 1892, pp. 1–8, pl. 1, 2 diagrams.

Refers to extent of injury from rusts, etc., in all parts of the world. Quotes from Bolley as to occurrence in the United States, and notes its being found in India. Australia, Japan, etc. Estimates loss to wheat growers in India at nearly 3,000,000 rupees annually. (J. F. J.)

702. BOLLEY, H. L. **Potato scab, a bacterial disease.** <Proc. Am. Asso. Adv. Sci., vol. XXXIX, Salem, Mass., July, 1891, pp. 334–335.

Abstract giving a statement of contents of paper. Concludes the bacterial origin of disease to be proved by finding (1) a specific bacterium in the true scab; (2) raising diseased tubers from diseased seed and tubers free from disease from treated seed; (3) raising healthy tubers by isolation in same hill where all others became diseased; and (4) producing disease in healthy tubers by artificial infection. (See also, Nos. 119, 120, 121.) (J. F. J.)

703. C[HURCHILL, G. W.]. **Anthracnose of the bean.** <Cult. and Count. Gent., vol. LVII, Albany, N. Y., Feb. 4, 1892, p. 88, ½ col.

Refers to appearance of beans affected by the disease, and recommends that they be soaked before planting in solution of 3 oz. carbonate of copper dissolved in one quart of ammonia and diluted with 4½ gallons of water. The beans should be soaked in the solution for one hour. (J. F. J.)

704. COBB, N. A. **Notes on diseases of plants.** <Agric. Gaz. N. S. Wales, vol. II, Sydney, May, 1891, pp. 285–287.

Describes diseased horse-radish plants attacked by *Cystopus candidus*, and recommends as remedies rotation of crops and clean cultivation. Pulverized lime, flowers of sulphur, and eau celeste might also be tried. Recommends clean cultivation, destruction of diseased plants, and rotation of crops for diseases of maize caused by *Ustilago maydis* and *Puccinia maydis*. Under head of diseased lucerne, caused by *Sphærella destructiva*, refers to remedies previously given. (See No. 705.) Says in regard to "water core" of apple that it is not a fungus disease, but is due to lack of air and too much water. (M. V.)

705. COBB, N. A. **Pathological notes.** <Agric. Gaz. N. S. Wales, vol. II, Sydney, Feb., 1891, pp. 107–108, fig. 4.

Under subhead "A Disease of Lucerne" (*Sphærella destructiva* B. and B.), speaks of part of host attacked, the appearance and amount of the disease. Describes briefly microscopical appearance and germination of spores. Recommends good surface drainage and a rapid succession of close mowings. Reference is also made to sphæriaceous fungi and wheat rust spores, which have been scattered by currents of air and are found on red incrusted fence rails, together with a species of lichen, which is the true cause of the red color. (M. V.)

706. COBB, N. A. **Pathological notes.** <Agric. Gaz. N. S. Wales, vol. II, Sydney, April, 1891, p. 215.

Gives a popular description of maize affected with rust, the probable cause being *Puccinia maydis*. States also that apple scab may be almost entirely prevented by spraying trees once every two or three weeks in spring and summer with modified eau celeste. (M. V.)

707. [EDITORIAL.] **The potato disease.** <Mediterranean Nat., vol. I, Malta, Sept., 1891, p. 54, ½ col.

Notes two diseases affecting potatoes, one caused by *Phytophthora infestans*, the other by a bacterium, *Clostridium butyricum*. The last disease may be arrested by placing the potatoes, after they are dug, in "a light, dry, airy place." (J. F. J.)

708. FALCONER, WILLIAM. **Some notes on the celery crop.** <Cult. and Country Gent., vol. LVII, Albany, Jan. 14, 1892, pp. 28–29, ⅜ col.

Notes rusting of celery on Long Island; this prevents early blanching. (J. F. J.)

709. [?FAWCETT, W.] **Coffee-leaf disease.** <Bull. Bot. Dept. Jamaica, No. 22, Kingston, July, 1891, p. 3, ½ p.

Notes the danger of introduction of *Hemileia vastatrix* into Jamaica, and gives proclamation relative to destruction of coverings of tea chests to prevent introduction of the fungus spores from Java or Ceylon. (J. F. J.)

710. [?FAWCETT, W.] **Dr. Burck's method of treatment of the coffee-leaf disease in Java, [with notes].** <Bull. Bot. Dept. Jamaica, No. 22, Kingston, July, 1891, pp. 3–10.

An abstract, with notes, from a paper by Burck published in the "Javaasche Courant." States the disease is due to a fungus, *Hemileia vastatrix*, which attacks the lower surfaces of the leaves and gains entrance to the interior through the stomata. The spores develop only in water and in darkness, light and moisture together being destructive to them. The infection of the leaves is described and suggestions are made for cure or prevention. The third pair of leaves on each branch, is the one first attacked. If taken in time and the diseased spot punctured with a needle having on its tip a small amount of sulphuric acid, or if it be cut out with a pair of scissors made especially for the purpose, the disease can be checked. It can also be prevented by spraying with copper sulphate, sulphate of quinine and tobacco water. The expense of treating plants is very slight, not exceeding 1½ guilder cents each from the time of sowing until coming into bearing. Planting hedges so as to intercept the wind is also recommended. (J. F. J.)

711. [?FISCHER, A.] **Agricultural prospects generally.** <Agric. Journ. Dept. of Agric. of Cape Colony, vol. IV, Cape Town, Jan. 14, 1892, pp. 156–157.

Report from Graaff-Reinet states that rust is injuring wheat, some farmers reporting one-third of a crop lost. At Humansdorf nearly all soft wheat perished with rust, but hard wheat, such as Blaauw-Horn withstood the rust. Oat hay was injured by rust. At Peddie rust is reported bad on hard wheat; beans "rusted" in some parts of the district. The earlier varieties of grapes "are affected with rust." At Steynsburg and Uniondale rust is reported on wheat to some extent. (W. T. S.)

712. [?FISCHER, A.] **The wheat crop.** <Agric. Journ. Dept. of Agric. of Cape Colony, vol. IV, Cape Town, Jan. 14, 1892, pp. 155–156.

Additional reports from seed inspectors are given. Rust is reported as destructive at Dooren Kloof and Tarkastad in the eastern districts. At Dooren Kloof "the rust was worse this year than it has been for years; several people just burnt off their wheat to clean the lands; others cut it off for bedding for their horses. Even the best wheat reaped was rusty." (W. T. S.)

713. GALLOWAY, B. T., and SOUTHWORTH, E. A. **Preliminary notes on a new and destructive oat disease.** <Jour. Mycol., vol. VI, Washington, Sept. 10, 1890, pp. 72–73.

Give notes on a disease of oats caused by bacteria. Inoculations with the bacteria produced characteristic features of the disease in five days. Cultures yielded the typical organism in a nearly pure condition. (See abstract in Proc. Am. Asso. Adv. Sci., vol. 39, July, 1891, Salem, Mass., p. 333, six lines.) (J. F. J.)

714. HALSTED, B. D. **Black rust of cotton.** <Am. Agric., vol. L, New York, Oct., 1891, p. 539, ⅜ col.

A notice of various diseases to which cotton is subject and a special reference to a new disease produced by *Macrosporium rugricantium* Atkinson. Advocates keeping plants in good condition so as to ward off attacks of disease. (J. F. J.) (See No. 246*a*.)

715. HALSTED, B. D. **Experiments with sweet potatoes.** <Cult. and Country Gent., vol. LVII, Albany, Jan. 14, 1892, p. 28, 1½ col., 1 diagram.

Gives results of experiments with various manures and fertilizers on black rot and soil rot. (J. F. J.)

716. HALSTED, B. D. **Fungous diseases of various crops.** <Eleventh Ann. Rept. N. J. Agric. Ex. Sta., New Brunswick, 1891, pp. 345–366, fig. 3.

Gives notes upon various diseases of garden and ornamental crops. Notes presence of *Phytophthora infestans* as destructive in various parts of the State; also presence of the parasite in potatoes sent from Ireland. Notes occurrence of the bacterial blight of Burrill

and refers to the scab described by Thaxter and Bolley. Records *Plasmodiophora brassicæ* Wor., upon cabbage and radish, and for the first time in America *Peronospora parasitica* DBy., on leaves of cabbage and *Hesperis matronalis*. Notes also *Macrosporium brassicæ* Berk., on cabbage. *Cystopus candidus* (Pers.) Lév., is recorded as doing damage on radish, and a *sclerotial* disease of turnips and carrots is noticed. A bacterial disease of salsify is spoken of as quite widespread in the State and likely to prove very contagious. *Botrytis parasitica* and *Urocystis cepulæ* are reported as doing damage to onions and onion sets. Notes presence of *Cercospora flagilleformis* E. & Hals., n. sp. on spinach, and reviews work done in Bull. 70 of N. J. Ex. Sta. (See No. 135). Gives figures of *Phyllosticta hortorum* Speg., on the eggplant, where it causes serious losses, together with *Glœosporium melongenæ* E. & E. Figures, with description *Glœosporium piperatum* E. & E., and *Colletotrichum nigrum* E. & Hals., and notes a species of *Phyllosticta*, all three on the foliage of the pepper. Notes presence at Piscataway of *Septoria armoraciæ* Sacc., and *Ramularia armoraciæ* Fl., on leaves of horse radish. Discusses diseases of the cultivated hollyhock, *Puccinia malvacearum* Mont., *Cercospora althæina* Sacc., and *Colletotrichum malvarum* (B. & Casp.,) Southworth. The violet (*V. odorata*) diseases are reviewed shortly and mention made of *Cercospora violæ* Sacc., *Phyllosticta violæ* DBy., *Glœosporium violæ* B. & Br., and *Zygodesmus albidus* Ell. & Hals. The fungi especially troublesome to carnations mentioned are *Septoria dianthi* Desm., and *Vermicularia subeffigurata* Schw. *Cercospora resedæ* Fckl., on cultivated mignonette is mentioned as controlled by Bordeaux mixture. The black knot of plum and cherry trees is treated of and reference made to Bull. No. 78 N. J. Agric. Ex. Sta. Quotes report of J. M. White who was successful in the treatment of his Clairgeau and Deil pears for leaf-blight and cracking by use of ammoniacal solution, 6 oz. copper carbonate in 100 gallons of water. Mr. White estimates the cost of treating an orchard of 100 apple trees thirty to forty years old five times with carbonate of copper at about $20. (See Exper. Sta. Rec., vol. III, Dec., 1891, pp. 306–308.) (D. G. F.)

717. HALSTED, B. D. **Soil-rot of the sweet potato.** <Cult. and Country Gent., vol. LVI, Albany, N. Y., Mar. 5, 1891, p. 148, 1 col., fig. 1.

Gives popular description of disease with possible remedies. (See No. 53.) (D. G. F.)

718. HALSTED, B. D. **The black-rot of the sweet potato.** <Cult. and Country Gent., vol. LVI., Albany, N. Y., Feb. 5, 1891, p. 104, 2 cols., fig. 1.

Gives popular description of disease of sweet potato caused by *Ceratocystis fimbriata* Ell. & Hals. (See No. 53.) Reviewed in Popular Gardening, Buffalo, N. Y., vol. VI, Apr., 1891, p. 128. (See No. 264.) (D. G. F.)

719. HALSTED, B. D. **The scab of potatoes.** <Am. Agric., vol. LI, New York, Mar., 1892, p. 171, 1 col.

Gives a list of various theories advanced to account for scab. Concludes that real cause is a fungus. Gives outline of work of Bolley, Thaxter, Humphrey, and others, and mentions means advocated for its prevention. (J. F. J.)

720. HALSTED, B. D. **The southern tomato blight.** <Miss. Agric. and Mechanical Col. Exper. Sta., Bull. No. 19, Jan., 1892, Agric. Col., pp. 1–9, 11–12.

Describes disease and gives experiments in inoculation of tomatoes from diseased potatoes, and *vice versa*. Seedlings also experimented with, with rather unsatisfactory results. The conclusions are that the blight is due to a *bacterium*, probably the same as that causing the potato disease; that it is also the same as the blight of cucurbits, and can be transferred from one to the other, and that spraying with Bordeaux mixture will probably prove a remedy or preventive. (See Gard and Forest, vol. V., Mar. 2, 1892, p. 108; Exper. Sta. Rec., vol. III, May, 1892, p. 702.) (J. F. J.)

721. HALSTED, B. D., and FAIRCHILD, D. G. **Sweet potato black-rot.** <Jour. Mycol., vol. VII, Washington, Sept. 10, 1891, pp. 1–11, pl. I–III.

Describe the external appearance, characteristics, cultures, inoculations, probable life history, and preventive measures. The latter are selections of healthy seed potatoes, healthy sprouts for transplanting from hot bed, rotation of crops, burning of refuse, sparing use of barnyard manure, and dipping roots in ammoniacal solution of copper carbonate before storing in bins for winter. (J. F. J.)

722. HARVEY, F. L. **Causes of potato scab.** <Ann. Rept. Maine Agric. Ex. Sta., part IV, Orono, Dec. 31, 1890 (1891), pp. 115–117.

Reviews work of Thaxter and Bolley on subject. (See No. 311. Also Exper. Sta. Record, vol. III, Jan., 1892, pp. 395–396.) (D. G. F.)

723. KELLERMAN, W. A. **Rusts and smuts of wheat.** <Farm, Field and Stockman, vol. XV, Chicago, Feb. 13, 1892, p. 151, 1½ col.

Gives brief outline of life history of rust and smut, and recommends immersion of seeds in water heated to from 132° to 135° for prevention of smut. (B. T. G.)

724. LAGERHEIM, G. DE. **La enfermedad de los pepinos.** <Revista Ecuatoriana, tom. II, Quito, Dec., 1890, pp. 1–6.

Relates to a disease of Pepinos (*Solanum muricatum*) in Ecuador caused by *Phytophthora infestans*. A general account of the fungus is given, together with notes on distribution, hosts, remedies, etc. The author adopts Mille Libert's name *Phytophthora devastatrix*, on the ground of priority. (B. T. G.)

725. LAGERHEIM, G. DE. **Remarks on the fungus of a potato scab.** <Jour. Mycol., vol. VII, No. 2, Washington, Mar. 10, 1892, pp. 103–104.

The disease is caused by *Spongospora solani* Brunch., and was noticed in potatoes purchased in Quito, Ecuador. Describes minute characters of the fungus and gives a short synonymy of the species, concluding it should be known as *Spongospora subterranea* (Wallr.). (J. F. J.)

726. [MEEHAN, T.] **The potato disease.** <Meehan's Monthly, vol. II, Germantown, Pa., Jan., 1892, p. 13, ½ col.

Notes that spores of fungus do not penetrate the plant, but, falling to the ground, are carried to tubers by the rain and cause rot. Spores seldom penetrate the ground more than 4 inches, and hilling up the vines as early as possible in the season is recommended as a preventive of rot. (J. F. J.)

727. PAMMEL, L. H. **New fungous diseases of Iowa.** <Jour. Mycol., vol. VII, No. 2, Washington, Mar. 10, 1892, pp. 95–103.

Discusses fungi affecting cereals, fruits, and forest trees. Under the first are considered diseases of wheat, barley, timothy, brome grass, Panicum, and clover. Under fruit diseases are considered plum scab or black spot, anthracnose of currants, clustercup of gooseberries, black knot of plums, and white rust of beets. Under forest trees are discussed blight of *Æsculus*, cedar apple fungus, and walnut-tree diseases. (J. F. J.)

728. PAMMEL, L. H. **Potato scab.** <Orange Judd Farmer, vol. XI, Chicago, Jan. 9, 1892, p. 19, 2 col., fig. 1.

Gives popular résumé of recent investigations of Bolley and Thaxter upon the disease. (See Nos. 311, 120, and 121.) (D. G. F.)

729. PECK, C. H. **The potato rot fungus.** <Cult. and Count. Gent., vol. LVII, Albany, N. Y., Feb. 4, 1892, p. 85, ½ col.

Refers to losses caused by potato rot and to the value of Bordeaux mixture as a preventive. Gives formula. (J. F. J.)

730. PRILLIEUX & DELACROIX. **La nuile, maladie des melons, produite par le Scolecotrichum melophtorum, nov. sp.** <Bull. Soc. Mycol. France, vol. VII, Paris, Dec. 31, fasc. 4, 1891, pp. 218–220, fig. 1.

Gives description of external appearance of the diseased fruit and technical description of the fungus. Notes its successful cultivation in artificial media. (E. A. S.)

731. S——. **Die Kartoffelkrankheit in Irland.** <Naturwissensch. Wochenschr., vol. VI, Berlin, Aug. 30, 1891, p. 358.

Notices a disease affecting potatoes in Ireland caused by *Peziza sclerotiorum*. (J. F. J.)

732. SOUTHWORTH, E. A. **Anthracnose of cotton.** <Jour. Mycol., vol. VI, Washington, Jan. 6, 1891, pp. 100–105, pl. 1 (IV), fig. 1.

Disease due to a new species of fungus described under name of *Colletotrichum gossypii*. Mentions external appearance and effect on the boll. Botanical characters and general notes. States there is reason to fear it will be difficult to prevent disease by fungicides. (J. F. J.)

733. [SWINGLE, W. T.] **[Rust of cereals.]** <U. S. Dept. of Agric., Div. of Veg. Path., Cir. No. 12, Washington [Dec., 1891], p. 1.

A circular of inquiry to ascertain the amount of wheat rust in the country, varieties attacked, remedies, etc. (J. F. J.)

734. WEED, C. M. **The smut of oats.** <Am. Agric., vol. LI, New York, Mar., 1892, pp. 183–184, figs. 4.

Notes losses from smut in different years and localities and states it can be prevented, as discovered by Jensen, by soaking in hot water. Gives brief life history of fungus, with account of microscopic characters and remedies. The best method is treating seed with hot water at a temperature of 133° F. for five or ten minutes. (J. F. J.)

735. WEED, C. M. **Wheat "scab."** <Am. Agric., vol. L, New York, Dec., 1891, p. 693, 1 col., figs. 2.

Describes appearance of wheat affected by scab. Due to species of *Fusisporium*. Mentions great loss resulting from the disease. (J. F. J.)

736. WORONIN, M. **Ueber das "Taumelgetreide" in Süd-Ussurien.** <Bot. Zeit., 49 Jahr., Leipzig, Feb. 6, 1891, pp. 81–93.

In 1888 the author's attention was called to a serious disease of grains in South Ussuria, and in 1889 he received specimens from Wladywostok, together with drawings and descriptions of the fungi occuring thereon made by N. Paltschewsky and N. Epoff. Gives a short review of the literature of similar diseases of grains, stating that the appearance of "intoxicating grain" is no new phenomenon, it having been previously reported from Germany and Sweden. The diseased grain, when eaten, produces in men a serious disease; the principal symptoms being pain in the head, vertigo, nausea, loss of sight, etc. In South Ussuria besides rye, wheat, oats, millet, etc., were diseased, and not only men, but also animals

were affected by eating the grain. The following were found on the diseased grain: *Fusarium roseum* Lk., *Gibberella saubinetii* Sacc., *Cladosporium herbarum* Lk., *Helminthosporium* sp., *Epicoccum neglectum* Desm., *Trichothecium roseum* Lk., *Eurotium herbariorum* Lk., *Micrococcus* sp. [causing red grains], *Hymenula glumarum* Cke. & Horke., *Sphærella* or *Didymella*, *Cladochytrium graminis* Büsg. Besides these, some unidentified forms are enumerated, one of which, a black stroma, looked extremely like *Puccinia graminis*, which latter fungus was almost entirely absent. All of the fungi, except *Puccinia graminis* and *Cladochytrium graminis* (both of which were rare), are saprophytes, and are probably not the direct cause of the disease, which is considered to be due to the damp summer weather, inducing molding of the grain during curing. As a preventive measure, the practice of the neighboring people—Chinese and Coreans—is recommended. This consists simply in drying the grain under shelter and thus prevent its molding. Careful selection of seed is also enjoined. The cause of the disease produced in men and animals, the author thinks due to one or more of the following: *Fusarium roseum*, *Gibberella saubinetii*, *Helminthosporium* sp., *Cladosporium herbarum*. W. T. S.)

(See also Nos. 743, 827, 833, 840, 843, 864, 885, 973, and 984.)

III.—DISEASES OF FRUITS.

737. [ANON.] **Orange-tree diseases.** <Fla. Disp., Farmer and Fruit Grower, n. ser., vol. III, Jacksonville, July 16, 1891, p. 563.

Reports account of visit of Erwin F. Smith and W. T. Swingle, agents of the U. S. Dept. of Agric., to Florida to investigate the diseases of oranges. (D. G. F.)

738. ARGYNNIS [SHARPE, ALDA M.]. **Plums affected by fungus.** <Prairie Farmer, vol. LVIII, Chicago, July 4, 1891, p. 422, ½ col., fig. 1.

Figures plum with plum pockets, *Taphrina pruni*, giving short popular account of the disease. (D. G. F.)

739. BAILEY, A. **New disease of the orange.** <Fla. Agric., vol. XVIII, De Land, Nov. 11, 1891, p. 603, ⅔ col.

Describes disease on sweet orange similar to "scab." Appeared first on lemon and spread to oranges. Sulphur solution, 10 or 12 gallons to 40 gallons of water, partially checked the disease. (J. F. J.)

740. BRUNK, T. L. **Plum knots.** <Am. Farmer, 10th ser., vol. X, Baltimore, May 1, 1891, p. 102, ⅔ col.

Notes disease to be caused by *Spharea morbosa* [*sic*], and describes method of its propagation. Recommends painting knots with linseed oil in the spring, and then "no spores will be found in the warts and they will crumble and fall away." Red oxide of iron mixed with linseed oil gives perhaps better results than oil alone. Recommends also cutting out badly diseased trees. (J. F. J.)

741. BUTZ, GEO. C. **Black knot on plums.** <Ann. Rept. Penn. State College for 1890 Harrisburg, 1891, pp. 166–167, pl. 1.

(See No. 251.) (J. F. J.)

742. COBB, N. A. **Notes on diseases of plants.** <Agric. Gaz. N. S. Wales, vol. II, Sydney, Jan., 1891, pp. 60–62.

Gives a short popular description of anthracnose or black spot on grapevines, and condition favorable for its development; also three remedies. Gives formulæ for making Bordeaux mixture and eau celeste, speaks of the success of these remedies in Europe and America. Then treats of "pear blight" (*Fusicladium pirinum*). Speaks of the close resemblance of this fungus and that causing apple scab. Recommends ammonia-carbonate of copper to be used for spraying the trees and gives formulæ for making. Under head of strawberry leaf-blight mentions places from which specimens of this disease have been received and gives remedies for prevention. Under "Rust on marsh mallows" quotes from a letter that it is popularly believed this rust is in some way connected with wheat rust. Makes one or two statements to show that this is probably not true. (M. V.)

743. COBB, N. A. **Notes on diseases of plants.** <Agric. Gaz. N. S. Wales, vol. II, Sydney, Mar., 1891, pp. 155–157.

Gives popular description of bitter rot of apple (*Glœosporium versicolor*), showing also that the disease can be given to other fruits, such as peach, cherry, mango, etc.; mentions treatment. Notes presence of "pear mite" and *Fusicladium* and their resemblance to each other, giving remedies for both diseases. Linseed plants from India and New Zealand were attacked by *Melampsora lini*, which caused great loss; finally, for peach rust recommends burning leaves, spraying trees in winter with sulphate of iron (1 pound to 8 gallons of water), and application of potash manures. (M. V.)

744. COBB, N. A. **Notes on diseases of plants.** <Agric. Gaz. N. S. Wales, vol. II, Sydney, June, 1891, pp. 347–348.

Describes method of entrance of spores of common mold into core of apples, producing what is known as "moldy core." Recommends modified eau celeste as a probable remedy. Also quotes from Gardeners' Chronicle a description, by M. C. Cooke, of a new vine disease (*Glœosporium pestiferum*), received from Brisbane. (M. V.)

745. CUGINI, G., E MACCHIATI, L. **La Bacterosi dei grappoli della vite.** <Staz. Sper. Agr. Italiane, vol. XX, Giugno 1891 (18 Luglio), Asti, pp. 579–582.

Give preliminary report upon a bacterial disease of young grape clusters found in June, 1891, at several localities near Modena. The disease is manifested by a brown coloring and final drying up of the stems and pedicels of the young grapes and a consequent wilting of the immature berries. The organism (3–4 by 1–1½ μ), cultivated on gelatin, gives honey-yellow colonies with indefinite contours, which rapidly become confluent and liquefy the medium; also grows on potato, giving same colored colonies, but with sinuose margins. Find the bright yellow color to fade out upon extended cultivation in gelatin. No inoculations were reported on, but it is the intention of the authors to work out the life-history of the parasite. Think the malady likely to prove a most serious one. (D. G. F.)

746. DESPERSSIS, J. A. **Anthracnosis or black spot of the grape.** <Agric. Gaz. N. S. Wales, vol. II, Sydney, July, 1891, pp. 421–424, figs. 2.

Speaks of the microscopic fungus causing the disease. Sums up results of experiments carried on near Bordeaux to test different substances as preventives. Recommends several washes and powders, and speaks of methods of applying. (M. V.)

747. DETMERS, FREDA. **Apple scab (Fusicladium dendriticum, Fckl.).** <Ohio Agric. Exper. Sta., 2d ser., vol. IV, Bull. No. 9, Columbus, Dec., 1891, pp. 187–192, pl. V–VII.

Gives a list of apples subject to attacks of disease and describes its features. Discusses external characters, effects on host, and microscopical characters. (See Exper. Sta. Rec., vol. III, April, 1892, p. 620.) (J. F. J.)

748. GALLOWAY, B. T. **A new pear disease.** <Jour. Mycol., vol. VI, Washington, Jan. 6, 1891, pp. 113–114.

Describes a disease observed in Alabama due to *Thelephora pedicellata* Schw. Recommends cutting out diseased wood, washing with copperas or sulphate of iron, and coating wounds with wax or similar substance. This treatment was successful when tried. (J. F. J.)

749. HALSTED, B. D. **Bacterial melon blight.** <Miss. Agric. and Mechanical Coll. Exper. Sta., Bull. No. 19, Agric. College, Jan., 1892, pp. 9–11.

Describes disease due to bacterial germs, and mentions successful experiments in transferring disease from cucumbers to squashes, tomatoes, and potatoes. It thus seems to be the same disease in all these plants. (J. F. J.)

750. HALSTED, B. D. **Treatment of cranberry scald and cranberry gall fungus.** <Jour. Mycol, vol. VI, Washington, May 14, 1890, pp. 18–19.

A general description of the diseases, with directions for treatment. (See No. 204.) (J. F. J.)

751. KERR, J. W. **Plum knots.** <Am. Farmer, 10th ser., vol. X, Baltimore, May 1, 1891, p. 102, ½ col.

Recommends cutting out diseased trees and planting varieties not subject to the disease. Advocates discarding Damson plums altogether. (J. F. J.)

752. MARTELLI, [N.] **[Ceppi di vite affetti dalla cosi detta tubercolosi.]** <Nuovo Gior. Bot. Ital. (Bull. d. Soc.), vol. XXIII, 6 Aprile, 1891, Firenze, p. 550 [350].

Report by the secretary of the Society of a note presented on a doubtful bacterial disease of the vine called tuberculosis, and the exhibition of slide, showing the organism of the tuberculosis of the olive. (D. G. F.)

753. MARTELLI, N. **Il black-rot sulle viti presso firenze.** <Nuova Gior. Bot. Ital. (Bull. d. Soc.), vol. XXIII, 5 Ottobre, 1891, Firenze, pp. 604–610.

Discusses question of the presence of the black rot in Italy, deciding it to have made its first appearance in 1891, notwithstanding a previous report in 1877 by Arcangeli. Doubt is thrown on its correct identification by the fact that only the form on the leaf has been found. Refers to work of Viala, and especially to experiments of Galloway. (D. G. F.)

754. MORROW, J. D. **Fungi on fruit trees.** <Am. Farmer, 10th ser., vol. X, Baltimore, July 1, 1891, p. 149, 1¾ cols.

A general statement of what fungi are. Advocates good cultivation and not too much dependence upon fungicides. (J. F. J.)

755. PAMMEL, L. H. **Fungous diseases of sugar beet.** <Iowa Agric. Exper. Sta., Bull. No. 15, Des Moines, [Ames] Nov., 1891, pp. 234–254, pl. I–VII.

Discusses various diseases of sugar beet observed both in Europe and America. These are beet rust, caused by *Uromyces betæ*; white rust of beets, caused by *Cystopus bliti*; spot disease, caused by *Cercospora beticola*; root-rot disease, caused by Nematode worms; violet-root fungus, caused by *Rhizoctonia betæ*, and also by species of bacteria; scab of beets, caused by bacterial germ as shown by Bolley. The life history of these species is given. In summary states that spot disease can be checked by Bordeaux mixture or ammoniacal carbonate of copper. Beet scab and potato scab seem to be the same, and the two crops should not follow one another. They are liable to be carried from a diseased field to one not infected. [Reprint of article repaged, 16 pp.] (J. F. J.)

756. PIERCE, N. B. **A disease of almond trees.** <Jour. Mycol., vol. VII, No. 2, Washington, Mar. 10, 1892, pp. 66–77, pl. XI–XIV.

Describes the extent of the disease and the stocks affected. Gives an extended description of the general and special effects of the fungus, and discusses the spread of the disease. Gives general directions for prevention, mainly the collection and burning of fallen foliage and turning in the soil beneath the trees. Many details of germination and life history of the fungus are also given. The disease is due to *Cercospora circumscissa* Sacc. (J. F. J.) (See Pacific Rural Press, vol. XLIV, Aug. 20, 1892, p. 141, fig. 9.)

757. PIERCE, NEWTON B. **Tuberculosis of the olive.** <Jour. Mycol., vol. VI, Washington, Apr. 30, 1891, pp. 148–153, pl. XIV, XV.

Refers to the presence of this disease in the Mediterranean region of Europe, and quotes description by Savastano. Probably due to presence of bacteria. Cutting off affected branches seems to be all that is necessary to prevent disease spreading and doing damage. (J. F. J.)

758. SMITH, ERWIN F. **Field notes, 1890.** <Jour. Mycol., vol. VI, Washington, Jan. 6, 1891, pp. 107–110.

Gives short notes on peach-leaf curl (*Taphrina deformans* Tul.); plum taphrina; plum blight, apple blight (*Bacillus amylovorus* (Burrill) Trev.); pear leaf-blight (*Entomosporium maculatum* Lév.); black rot (*Læstadia bidwellii* (Ell.) V. and R.); vine blight; brown rot of the peach (*Monilia fructigena*); peach yellows and peach rosette. (J. F. J.)

759. SMITH, ERWIN F. **Field notes, 1891.** <Jour. Mycol., vol. VII, No. 2, Washington, Mar. 10, 1892, pp. 88–95.

Consists of notes on the following diseases: Peach curl, peach mildew, black spot of peaches, frosty mildew of peaches, peach rust, peach rot, peach yellows, clubbed branches of peach, stem and root tumors, peach rosette, pear diseases, and sycamore blight. (J. F. J.)

760. SMITH, ERWIN F. **Peach blight.** <Jour. Mycol., vol. VII, Washington, Sept. 10, 1891, pp. 36–39, pl. V, VI.

Describes appearance of disease and its manner of working on the tissues of plant. Penetrates the blossoms and then spreads to twigs. Gives results of experiments to secure fruiting specimens of the fungus (*Monilia fructigena*), and describes its effect upon the woody tissues. (J. F. J.)

761. SOUTHWORTH, E. A. **Ripe rot of grapes and apples.** <Jour. Mycol. vol. VI, Washington, April 30, 1891, pp. 164–173, pl. 1 (XV).

Gives general outline of history of the fungus (*Glœosporium fructigenum* Berkl.) which is the same as that producing bitter rot in apples. The external characters and microscopic characters are fully described. Under "treatment" gives the results of an experiment, showing that spraying with potassium sulphide and ammoniacal copper carbonate produced good results with apples. The same treatments would probably also protect grapes. (J. F. J.)

762. THÜMEN, FELIX. **Die Black Rot Krankheit der Weinreben (Phoma uvicola, Berk. and Curt.), Physalospora bidwellii (Sacc.).** <Allgemeinen Weinzeitung, Wien, 1891, pp. 1–29.

A general account of black rot of the grape, based for the most part on papers by American authors. (B. T. G.)

763. UNDERWOOD, L. M. **Diseases of the orange in Florida.** <Jour. Mycol., vol. VII, Washington, Sept. 10, 1891, pp. 27–36.

Gives notes on orange diseases, with mention of causes, distribution, and remedies. The diseases treated are die-back, foot-rot (Mal-di-Goma), blight, scab, leaf-spot, sooty-mold, and leaf-glaze. The last is due to growth of a lichen. (J. F. J.)

(See also, Nos. 704, 706, 716, 727, 765, 789, 832, 833, 838, 850, 854, 871, 897, 910, 976, and 995.)

IV.—DISEASES OF FOREST AND SHADE TREES.

764. [ANON]. **Dr. Mayr on the parasitic fungi of North American forest trees.** <Gard. and Forest, vol. V, N. Y., Jan. 27, 1892, pp. 37–38.

Refers to examination of original specimens of Dr. Mayr, and gives as conclusions that *Rhytisma punctiforme* Mayr is *R. punctatum* Fries. *Microsphæria corni* Mayr is *M. pulchra* Cke. and Pk. *Lophodermium infectans* Mayr and *Hysteriopsis acicola* are considered too imperfect to say more than that they belong to the order of Hysteriaceæ. No good reason exists for the genus *Hysteriopsis* Mayr. Examination of *Puccinidia abietis* Mayr shows that what is called the *uredospore* is not a *Uredo*, but a species of *Tuberculina*, which infects *Uredineæ*. Uncertainty exists as to whether the species is *T. persicina* or a closely allied species. A second parasite attacking the *Tuberculina* is stated to be what Mayr considered the teleutospores of the Æcidium, whose form is too indefinite to determine. (J. F. J.)

765. BAIL. **Verschiedene Mittheilung.** <Schrift. Naturf. Gesells. in Danzig, neue folge, 7 Bd. Danzig, 1891, pp. 22–25.

Mentions collection of *Melampsora gœppertiana* on *Vaccinium vitis-idæa* ("Preiselbeer"). Near Ilmenau, Thüringen finds *Sclerotinia baccarum* causing a disease of berries of Vaccinium; *Peziza willkommii*, causing canker of the larch; *Lophodermium brachysporum*, causing the falling of pine leaves. A few other species of fungi are commented on. (W. T. S.)

766. FARLOW, W. G. **Diseases of trees likely to follow mechanical injuries.** [Boston, 1891, pp. 15.]

A paper read before the Massachusetts Horticultural Society, March 7, 1891, giving a statement of the structure of wood and the manner of healing of wounds. Refers also to the manner in which fungous germs find entrance into the wood and the bad effects likely to follow. (J. F. J.)

767 [MEEHAN, T.]. **The European plane.** <Meehan's Monthly, vol. II, Germantown, Pa., Jan., 1892, p. 11, ½ col.

Notes that in Ghent the European plane tree suffers from *Glœosporium nervisequum*, the leaves falling from its effects early in autumn. Sulphate of copper recommended as a specific. (J. F. J.)

768. PASQUALE, F. **Rapporto al chiarissimo sig. Direttore del R. arsenale di artiglieria in Napoli sul legname di Pioppo attaccato da micro-organismi.** <Nuovo Gior. Bot. Ital., (Bull. d. Soc.), vol. XXIII, Firenze, 8 Guinaio, 1891, pp. 184–186.

Gives preliminary note on a disease of poplar timber reported by the Director of the Artillery Arsenal at Naples, caused by a species of *Micrococcus*. Occurs in boards badly stacked, living in the wood vessels and causing yellow discolorations, and a final destruction of the tracheæ. Organism not cultivated. (D. G. F.)

769. VUILLEMIN, PAUL. **Remarques ètiologiques sur la maladie du Peuplier pyramidal.** <Rev. Mycol., XIV, Toulouse, Jan. 1, 1892, pp. 22–27, pl. 1.

Describes a new fungus *Didymosphaeria populina* and discusses the relation to the disease of severe winters, vegetative reproduction, etc. (E. A. S.)

(See also, Nos. 727 and 759.)

V.—DISEASES OF ORNAMENTAL PLANTS.

770. ARTHUR, J. C. **Carnation rust, a new and destructive disease.** <Am. Florist, vol. VI, Chicago and New York, Feb. 18, 1892, pp. 587–589, fig. 4.

Refers to the recent observance of a carnation disease and its wide extent in the United States. Cause stated to be *Uromyces caryophyllinus*. Gives general history of fungus and suggestions for treatment. Bordeaux mixture and ammoniacal solution of copper carbonate, both effectual remedies. (See also, Cult. and Country Gent., vol. LVII, Mar. 10, 1892, p. 188, fig. 1; Garden and Forest, vol. V, Jan. 13, 1892, p. 18.) (J. F. J.)

771. GALLOWAY, B. T. **Disease of geraniums.** <Jour. Mycol., vol. VI, Washington, Jan. 6, 1891, pp. 114–115.

States the disease is probably due to the presence of a *Bacillus*. Disease had been produced in several instances by inoculations directly from diseased plants. (J. F. J.)

772. HALSTED, B. D. **Fungous troubles in the cutting beds.** <Gard. and Forest, vol. V, New York, Feb. 24, 1892, pp. 91–92.

States that diseases of various sorts have appeared on cuttings, particularly of the carnation, rose, clematis, passion flower, and chrysanthemum. In the carnation, due to species of *Colletotrichum;* in the rose, to a species of *Glœosporium;* in the chrysanthemum, to a species of *Septoria* or *Phyllosticta;* in Abutilon, to a species of *Colletotrichum*, probably identical with that on carnation; in nasturtium probably also the same species. (J. F. J.)

773. HUMPHREYS, ALFRED. **The violet disease.** <Am. Florist, vol. VII, Chicago and New York, Jan. 28, 1892, pp. 521–522.

Replies to C. D. Wadsworth that if an insect or a parasite is the cause of violets losing their leaves, is not that a disease? Mentions effects observed by himself on both violets and on celery. Gives method of cultivating the violet. (J. F. J.)

774. [MEEHAN, T.] **Disease in Clematis.** <Meehan's Monthly, vol. I, Germantown, Pa., Nov., 1891, p. 74, ½ col.

Refers to disease as probably of fungous origin, and recommends watering with a solution of copper, made by dropping pieces of blue copperas about the size of an egg in a barrel of water. Draw earth away from plant and form a basin, in which pour the solution to insure its reaching the "collar" of the plant, the point usually attacked by the fungus. (J. F. J.)

775. [MEEHAN, T.] **Rhododendron disease.** <Meehan's Monthly, vol. II, Germantown, Pa., Nov., 1891, p. 72, 1 col.

Refers to yellowing and dropping of leaves of Rhododendron. Thinks it may be due to attacks of *Agaricus melleus*, but more likely to an oversaturated soil. Recommends under draining. (J. F. J.)

776. [MEEHAN, T.] **Violet diseases.** <Meehan's Monthly, vol. II, Germantown, Pa., Jan., 1892, p. 8, ½ col.

Brief note on disease caused by fungi. Spraying with solution of sulphate of copper recommended. (J. F. J.)

777. S. ———. [The violet disease.] <Am. Florist, vol. VII, Chicago and New York, Jan. 28, 1892, p. 522, $\frac{1}{5}$ col.

States trouble to spread most rapidly in weather with extreme and sudden changes in temperature. Believes careful cultivation will be effectual preventive. Notes similar trouble with chrysanthemums. (J. F. J.)

778. [SANDERS, EDGAR.] **The carnation rust.** <Prairie Farmer, vol. LXIV, Chicago, Mar. 5, 1892, p. 151, $\frac{2}{3}$ col.

Refers to paper by Arthur (see No. 770) and states that disease may be combated with sulphate of iron ($\frac{1}{3}$ to $\frac{1}{2}$ pound to a gallon of water), by Bordeaux mixture (probably), and also by ammoniacal copper carbonate. (J. F. J.)

779. SOUTHWORTH, E. A. **Additional observations on anthracnose of the hollyhock.** <Jour. Mycol., vol. VI, Washington, Jan. 6, 1891, pp. 115-116.

States that a fungus similar to that of diseased hollyhocks has been found in Kansas on *Sida spinosa*. Thinks it probable the species should be known as *Colletotrichum malvarum* (Br. and Casp.). Notes also that *C. bromi* Jennings from Texas may be same as *Steirochœte graminicola* (Ces.) Sacc. (J. F. J.)

780. SOUTHWORTH, E. A. **A new hollyhock disease.** <Jour. Mycol., vol. VI., Washington, Sept. 10, 1890, pp. 45–50, pl. 1, (III.)

Describes damage occasioned by a new disease of Hollyhocks, caused by *Colletotrichum althææ* n. sp. Gives external and botanical characters and recommends Bordeaux mixture as a remedy. (J. F. J.)

(See also Nos. 843 and 971.)

D.—REMEDIES, PREVENTIVES, APPLIANCES, ETC.

781. ALWOOD, WILLIAM B. **Current notes.** <Southern Planter, 51st year, Richmond, Va., June, 1890, pp. 274-276.

Notes treatment of apple scab and black rot of grapes in Albemarle County, Va., and refers to fact that he prepared a bill against peach yellows which was passed with serious amendment by the legislature. (D. G. F.)

782. ALWOOD, WILLIAM B. **Notes on treatment of grapes.** <Southern Planter, 52d year, Richmond, Va., May, 1891, p. 249, $1\frac{1}{2}$ col.

Gives instructions for treatment of grape diseases by use of ordinary copper compounds. (D. G. F.)

783. ALWOOD, WILLIAM B. **Standard fittings for spray machinery.** <Insect Life, vol. IV, Washington, Oct., 1891, pp. 58-59.

Brief report of committee appointed to confer with makers of spraying machines to secure standard sizes of styles and fittings for machines. (J. F. J.)

784. ALWOOD, WILLIAM B. **Treatment of black rot of grapes. Note on Bordeaux mixture—A modification of the copper carbonate preparation.** <Southern Planter, 51st year, Richmond, Va., Oct., 1890, p. 462, 2 cols.

Claims to have discovered that it required only $1\frac{1}{4}$ parts of quicklime to neutralize 1 part of copper sulphate and discovered independently of several French investigators that the formula might be reduced. Gives the reduced formula as 2 pounds of copper sulphate and $2\frac{1}{2}$ pounds of lime. Claims priority in the preparation of the well known "Masson" mixture of copper carbonate from copper sulphate and sodium carbonate. Gives as date of discovery, spring of 1888. [See Patrigeon, G. Prog. Ag. et Vit. 4 anné 3 Juillet, 1887, p. 17.] (D. G. F.)

785. [ANON.] **Apple scab.** <Am. Agric., vol. LI, New York, Feb., 1892, p. 139, $\frac{1}{4}$ col.

Notes that "black mildew" of a correspondent is probably apple scab (*Fusicladium dendriticum*). Gives statement of how to treat disease, using solution of 4 pounds sulphate of iron to 4 gallons of water. (J. F. J.)

786. [ANON.] **Bordeaux mixture for potato diseases.** <Agric. Journ. Dept. of Agric. of Cape Colony, vol. IV, Cape Town, Jan. 14, 1892, p. 160, $\frac{1}{4}$ col.

A paragraph credited to the *Standard* states that "unless the sulphate of copper is neutralized by the admixture of a sufficient quantity of good and fresh quicklime, it is injurious to vegetation." The mixture should show no acidity when tested by means of litmus paper. Equal proportions of lime and copper sulphate are recommended instead of one part of lime to two of copper sulphate as formerly advised. (W. T. S.)

787. [ANON.] **Machines and processes for destroying insect and fungus pests.** <Agri. Gaz. N. S. Wales, vol. II, Sydney, Feb., 1891, pp. 79–81.

A classification of machines and award of certificate of merit to manufacturer of the best machine. (M. V.)

788. [ANON.] **Mildew in grapes.** <Am. Agric., vol. L, New York, May, 1891, pp. 298-299, $\frac{1}{4}$ col.

Refers to powdery and downy mildew, recommending for the former sulphuring and for the latter ammoniacal solution of copper carbonate. Gives formula for the same. (J. F. J.)

789. [ANON.] **Pear leaf-blight.** <Orange Judd Farmer, vol. XI, Chicago, Jan. 21, 1892, p. 5, fig. 2.

Quotes from report of Secretary of Agriculture in relation to value of ammoniacal copper carbonate solution for pear leaf-blight. Preferable to Bordeaux mixture because about as effectual and cheaper. Costs $3\frac{3}{4}$ cents per tree for Bordeaux, against $2\frac{1}{4}$ cents per tree for copper carbonate solution. (J. F. J.)

790. [ANON.] **Poisons on fruit.** <Cult. and Country Gent., vol. LVII, Feb. 18, 1892, Albany, N. Y., p. 128, $\frac{3}{8}$ col.

Discusses the use of fungicides containing copper and the liability of danger from use of fruit sprayed with them, concluding that there is really more copper in many articles commonly eaten than is found in sprayed grapes. (J. F. J.)

791. [ANON.] **Preventive for plum-rot.** <Am. Gardening, vol. XIII, New York, Mar., 1892, pp. 180-181, $\frac{1}{6}$ col.

Directions for treating *Monilia fructigena.* Burn leaves, etc., in autumn; spray before buds open in spring with iron sulphate, and after flowers open spray with sulphide of potassium. (J. F. J.)

792. [ANON.] **Remedy for flea-beetle and blight [on potatoes].** <Am. Gardening, vol. XIII, New York, Mar., 1892, p. 180, $\frac{1}{6}$ col.

States that Bordeaux mixture will prevent blight of potato, as may also ammoniacal solution of copper carbonate. Doubt expressed as to whether it will pay to treat vines. (J. F. J.)

793. [ANON.] **Rot among late potatoes.** <Am. Farmer, 10th ser., vol. X, Baltimore, Aug. 1, 1891, pp. 170-171, $\frac{2}{3}$ col.

Recommends early planting and harvesting for prevention of rot. Bordeaux mixture and other copper compounds, together with London purple, will prevent the disease and kill insect pests at the same time. Article quoted from American Cultivator. (J. F. J.)

794. [ANON.] **Scabby pears.** <Cult. and Country Gent., vol. LVII, Albany, N. Y., Jan. 21, 1892, p. 47, $\frac{1}{3}$ col.

Query as to cure for scabby pears answered by saying that fertilizing and manuring will not be effective. Spraying with copper solution has been tried, but without positive results. (J. F. J.)

795. [ANON.] **Sulphate of copper and lime for vine mildew.** <Agric. Gaz. N. S. Wales, vol. II, Sydney, Sept., 1891, p. 557.

Mentions the report of the British consul at Bordeaux, in which a reference is made to this subject. Says that numerous scientific analyses were made showing that the amount of copper in wine made from sprayed vines was so small that human health could not be injured by it. Another investigation was made a few months ago and confirmed this result. (M. V.)

796. [ANON.] **Sulphate of copper and the potato disease.** <Gard. Chron., 3d ser., vol. XI, Jan. 9, 1892, London, p. 50, $\frac{1}{4}$ col.

States that experiments concluded last year by the Agricultural Society are described in detail in their journal. The remedy has not prevented the disease, but has lessened its amount. Advises early planting. (M. B. W.)

797. [ANON.] **The Strawsonizer.** <Agric. Gaz. N. S. Wales, vol. II, Sidney, Mar., 1891, p. 160.

Description of a machine designed for spraying with liquids or powders, sowing seed, and distributing manure. Gives account of trial made with it. (M. V.)

798. [ANON.] **The Strawsonizer.** <Agric. Gaz. N. S. Wales, vol. II, Apr., 1891, p. 224.

Notes tediousness of distributing sulphur on vines affected with *Oidium* by means of bellows, and says Strawsonizer sulphurs evenly and quickly, implying its value for sulphuring vines. (M. V.)

799. BARRY, W. C. **[Presidential address to the western New York Horticultural society.]** <Union and Advertiser, Rochester, N. Y., Jan. 27, 1892.

Under the head of "Insecticides and fungicides" refers to successful use of Bordeaux mixture in combating plant diseases. Carbonate of copper considered a remedy for apple scab (*Fusicladium dendriticum*). Reference is also made to presence of sulphate of copper and blue vitriol on grapes and the little danger from use of sprayed grapes. (J. F. J.)

800. BEACH, S. A. **Copper soils and vegetation.** <Cult. and Country Gent., vol. LVII, Albany, N. Y., Jan. 28, 1892, p. 68, 1 col.

Gives results of preliminary greenhouse experiments with peas and tomato seeds grown in soil containing 1 to 5 per cent of copper sulphate. Finds germination accelerated by presence of sulphate but maturity also hastened and plantlets dwarfed. Reports analyses from soil of old potato field showing presence of copper in distinct quantities. Concludes that nearly eleven hundred years would be required to impregnate to the extent of 1 per cent a layer of soil 1 foot deep by ordinary methods of spraying usually employed. (D. G. F.)

801. Berlese, A. N., ed Sostegni, L. **Osservazioni sull'idea di preservare la vite dal l'invasione della Peronospora mediante la cura interna preventiva con solfato di rame.** <Staz. Sper. Agr. Italiene, vol. xxi, Asti, Settem., 1891 (18 Ottobre, 1891), pp. 229-233.

Discuss results of two experiments with small quantities of soil treated with copper sulphate showing the sulphate to be decomposed in the soil and absorbed by it. Decide absorption power of calcareous soil to equal 46,822 Kg. of copper sulphate per hectare. Suggest that plants may absorb the copper in small quantities and inquire if this may not be turned to account in the treatment of diseases. (D. G. F.)

802. Bunzli, J. H. **Combating the potato blight.** <Jour. Mycol., vol. vi, Washington, Sept. 10, 1890, pp. 78-79.

Gives experiments made with different fungicides. Concludes the best results were obtained from the use of Bordeaux mixture and copper-soda solution, the latter made with 4 pounds 6 ounces copper sulphate, 6 pounds 10 ounces soda, and 26 gallons of water. Plants should be sprayed twice. (J. F. J.)

803. Butz, Geo. C. **Implements and materials tested [in 1890].** <Penn. Agric. Ex. Sta., Bull. No. 14, State College, Jan., 1891, pp. 12-13.

Describes the "Victor" spraying pump, manufactured by the Field Force Pump Company, Lockport, N. Y. (J. F. J.)

804. Charles, M. P. **Les tomates sulfatées.** <Jour. Phar. et Chimie, 5e ser., t. xxiv, Paris, 1891, p. 145.

Gives an account of a scare in France over the treatment of tomatoes by Bordeaux mixture. Shows that the amount is too small to be injurious and is found principally in the seeds of the fruit. Refers to the fact that bread, coffee, tea, and especially cocoa, contain large amounts of copper, as does also liver of beef. Refers to action of prefect of police. (D. G. F.) (Reviewed in Staz. Sper. Agrarie Italiene, vol. xxi, fac. iii, 1891, p. 291.)

805. Chester, F. D. **The copper salts as fungicides.** <Jour. Mycol., vol. vi, Washington, May 14, 1890, pp. 21-24.

A statement of the constituents of Bordeaux mixture, eau celeste, eau celeste modified, and ammoniacal copper carbonate, with the chemical reactions of each. (J. F. J.)

806. Cobb, N. A. **Notes on diseases of plants.** <Agric. Gaz. N. S. Wales, vol. ii, Sydney, Aug., 1891, p. 492.

Speaking of apple scab (*Fusicladium dendriticum*) recommends eau celeste (modified) as a remedy. Recommends Bordeaux mixture as a preventive of strawberry leaf blight (*Sphærella fragariæ*). Under the subhead "Experiments with the Strawsonizer for prevention of wheat rust" gives suggestions as to method of using in experiment. (M. V.)

807. Coste, H. **Instruction pratique sur les traitements à effectuer contre le mildew et l'anthracnose.** <Ann. Soc. d'hort. et d'hist. nat. de l'Hérault. 2 sér., tome xxiii, Montpellier, May and June, 1891, pp. 178-182.

The departmental professor of agriculture is sponsor for the following statements which occur in a work designed for general distribution. For grape mildew (*Peronospora*) the Bordeaux mixture has been found to give the most satisfactory results, but eau celeste, containing a part of the hydrated oxide of copper in an immediately soluble form, is a very active remedy, useful when vines are already attacked. Directions are given for making and applying Bordeaux mixture and eau celeste. If liquid fungicides are preferable, ordinarily, to powders, the latter may be of great service when the berries begin to be attacked. The two treatments may be combined, the Bordeaux or eau celeste being followed the day after by Skawinski, cupro-steatite, sulfo steatite, or sulphated sulphur—the first two on vines still free, the latter on vines already attacked. They should be applied mornings when dew is on, or quiet evenings. Anthracnose attacks principally the berries of Alicante Bouchet and Carignane. The Aramon, a variety which has heretofore remained almost exempt, is now one of the most attacked by punctate anthracnose. No radical remedy is known. Four have been used—sulphur, lime, cement, and gypsum. Employed separately they have some value, but are more efficacious when mixed in the following ways: (1) $\frac{1}{3}$ sulphur and $\frac{2}{3}$ lime of *Teil*. (2) $\frac{1}{3}$ sulphur and $\frac{2}{3}$ cement; (3) $\frac{1}{3}$ sulphur and $\frac{1}{3}$ lime of *Teil*, $\frac{1}{3}$ cement; (4) $\frac{1}{3}$ sulphur and $\frac{1}{3}$ lime of *Teil*, $\frac{1}{3}$ baked plaster. These mixtures should be used copiously in still evenings or mornings when there is dew. The following wash is recommended for use in the spring on vines already attacked: Dissolve 50 per cent sulphate of iron in warm water, after having wet the crystals with 1 per cent of sulphuric acid. The substance should be put on some days before vegetation begins with a brush or with a spraying machine. (E. F. S.)

808. Crozier, A. A. **On the effects of certain fungicides upon the vitality of seeds.** <Jour. Mycol., vol. vi, Washington, Mar., 1890, pp. 8-11.

Gives results of experiments with blue vitriol on corn (a teaspoonful in half a saucer of water; also 5 pounds vitriol to 10 gallons of water); in both cases germination was retarded. Blue vitriol on wheat (5 pounds to 10 gallons of water) also had bad effect on germination. Copperas on corn was tried with a like injurious effect. The seed in these trials was soaked from ten minutes to twenty-four hours. (J. F. J.)

809. Dimmock, Geo. **Electricity in agriculture.** <Science, vol. 19, New York, Feb. 19, 1892, p. 109, $\frac{1}{3}$ col.

Refers to paper by C. Warner (see No. 867) and queries whether the copper in the electric wires rather than the electric current was the cause of the freedom from mildew. (J. F. J.)

810. Durand et Galen. **Traitement du Mildiou par le verdet Gris.** <Montpellier, Ricard Fréres, 1892, pp. 12.

Present arguments in favor of the use of verdet or acetate of copper over Bordeaux mixture in the treatment of *Peronospora viticola*. (D. G. F.)

811. [Editorial.] **"Poisoned" apples.** <Cult. and Count. Gent., vol. LVII, Albany, Feb. 18, 1892, p. 130, ⅔ col.

Refers to fear in England of eating apples sprayed with copper preparations, and points out absurdity of belief in any danger from this source. (J. F. J.)

812. [Editorial.] **[Sulphate of copper for potatoes.]** <Science Gossip, No. 317, London, May, 1891, p. 112, ⅛ col.

Notes sulphate of copper as an antidote for potato disease as well as inducing a heavier crop. (J. F. J.)

813. [Fairchild, D. G.] **Sprayed fruit harmless.** <Democrat and Chronicle, Rochester, N. Y., Feb. 1, 1892.

An article prepared by a committee of the Western New York Horticultural Society, consisting mainly of an abstract of a paper by D. G. Fairchild. Reference is made to the presence of copper in many articles of common use as well as in sprayed grapes. Analyses show the maximum amount of copper to be ⅛ of a grain per pound of fruit. A summary of analyses made by Van Slyke is given, and the conclusion positively announced that it is impossible for a person to get enough copper from the fruit to be injurious to health. (J. F. J.)

814. Fairchild, D. G. **The toxicology of the copper compounds when applied as fungicides.** <Union and Advertiser, Rochester, N. Y., Jan. 28, 1892.

Abstract of paper read before Western New York Horticultural Society, advocating use of Bordeaux mixture and ammoniacal solution of copper carbonate, and suggesting a reduction in amount of copper used in Bordeaux mixture, using 65 to 75 gallons of water [instead of 45] to 6 pounds of copper sulphate and 4 pounds of lime. (See Gard. and Forest, vol. V, Feb. 10, 1892, p. 71.) (J. F. J.)

815. Galloway, B. T. **Cans't thou minister to a plant diseased?** <Rural New Yorker, vol. L, New York, Dec. 19, 1891, pp. 880–881.

Refers to early belief as to the origin of blights or mildews, and to the later investigations as to their causes. These were carried on especially by the Section of Vegetable Pathology established in 1885, and as a result the scientific farmer is able to conquer diseases which previously had wrought great havoc among his crops. (J. F. J.)

816. Galloway, B. T. **Description of a new knapsack sprayer.** <Jour. Mycol., vol. VI, Washington, Sept. 10, 1890, pp. 51–59, figs. 10.

A detailed description of a new and low-priced knapsack sprayer, estimated to cost $10.87. Manufactured by Albinson & Co., Washington, D. C. (J. F. J.)

817. Galloway, B. T. **Does it pay to spray?** <Am. Farmer, 10th ser., vol. X, Baltimore, Oct. 15, 1891, p. 232, 1½ cols.

Gives result of use of fungicides, especially Bordeaux mixture, for black rot, also for pear leaf-blight and scab. (J. F. J.)

818. Galloway, B. T. **Notes on fungicides and a new spraying pump.** <Jour. Mycol., vol. VI, Washington, May 14, 1890, pp. 25–26.

Gives a formula for preparation of copper acetate or verdigris; also one for a fungicide for downy mildew of grape. Announces that a new and cheap knapsack spraying pump will be put on the market in a few weeks. (J. F. J.)

819. Galloway, B. T. **Suggestions in regard to the treatment of Cercospora circumscissa.** <Jour. Mycol., vol. VII, No. 2, Washington, Mar. 10, 1892, pp. 77–78.

Gives methods of treatment based on experiments made on similar diseases in Australia. Recommends ammoniacal solution of copper carbonate in proportions of 5 ounces copper carbonate, 3 pints aqua ammonia, and 45 gallons of water. Details given as to method of applying fungicide and a recipe for making copper carbonate at home at expense of about 18 cents per pound. (J. F. J.)

820. Galloway, B. T. **Treatment of black rot, brown rot, downy mildew, powdery mildew, and anthracnose of the grape; pear scab and leaf-blight, and apple powdery mildew.** <Jour. Mycol., vol. VI, Washington, Mar., 1890, pp. 11–15.

Gives statement of mode of treatment of diseases mentioned in title, with formulæ for various fungicides. (J. F. J.)

821. Galloway, B. T. **Experiments in the treatment of plant diseases. Part III.** <Jour. Mycol., vol. VII, Washington, Sept. 10, 1891, pp. 12–16, fig. 1.

Gives details of experiments on grape diseases to determine the comparative value of various fungicides; the value of mixed treatment and value of early as compared with late sprayings. The conclusions were that Bordeaux mixture heads the list as a preventive against black rot; copper carbonate in suspension and milk of lime are comparatively useless; copper acetate is liable to injure the foliage, as is also mixture No. 5. Early sprayings are absolutely necessary to insure the best results. (J. F. J.) (For Parts I and II see Nos. 824 and 825.)

822. Galloway, B. T. **Note [on paper by Newcombe on "Perennial mycelium of the fungus of blackberry rust"].** <Jour. Mycol., vol. vi, Washington, Jan. 6, 1891, pp. 106–107.

Refers to value of treatment with fungicides for prevention of rust. Concludes it is only indirectly beneficial and advocates grubbing up diseased plants. (J. F. J.) (See No. 976).

823. Galloway, B. T. **The improved Japy knapsack sprayer.** <Jour. Mycol., vol. vii, Washington, Sept. 10, 1891, pp. 39–41, pl. vii–ix.

Describes in detail an improved sprayer, estimating it to cost from $10 to $12. (J. F. J.)

824. Galloway, B. T., and Fairchild, D. G. **Experiments in the treatment of plant diseases. Part I.** <Jour. Mycol., vol. vi, Washington, Jan. 6, 1891, pp. 89–99.

Describe treatment of black rot of grapes giving details of experiments made at Vienna, Va., to determine: (1) Best means of applying preparations; (2) relative value of Bordeaux mixture, ammoniacal copper carbonate solution, copper carbonate in suspension, and a mixed treatment of the first two; (3) actual cost of each treatment; (4) amount of copper found on fruit. The amount of fruit saved by the various treatments varied from 93.64 per cent to 99.20 per cent. The expense varied from .0077 cent to .008 cent per pound of fruit. The conclusion reached was that of the three treatments that with ammoniacal solution was the most profitable. Give also report on diseases of the grape in western New York, the special object being to investigate "blight" or "rust." Give characters of disease with causes and suggestions for treatment. Underdraining and late pruning are suggested. Brief reference to other diseases. (J. F. J.)

825. Galloway, B. T., and Fairchild, D. G. **Experiments in the treatment of plant diseases. Part II.** <Jour. Mycol., vol. vi, Washington, April 30, 1891, pp. 137–142.

Give details of experiments on pear leaf-blight and scab with five different fungicides, viz: Bordeaux mixture, ammoniacal solution, copper acetate, mixture No. 5, and copper carbonate in suspension. The first two gave the best results, the Bordeaux mixture being considered the better. For pear scab the experiments indicate that the sprayings should be made very early and that Bordeaux mixture is most to be relied on. (J. F. J.)

826. Gardner, H. **Viticulture. Statistics of grape growing and wine production in the United States.** <Census Bulletin, No. 38, Washington, Mar. 10, 1891, pp. 11.

Gives general statistics of grape culture in the United States and mentions successful use of the fungicides recommended by the Department of Agriculture for combating grape diseases. (J. F. J.)

827. Girard, Aimé. **Recherches sur l'adhérence aux feuilles des plantes et notament de la pomme de terre des composés cuivriques destinés a combattre lours maladies.** <Journ. d'Agric. Prat., 56 Année, t. i, Paris, Feb. 4, 1892, pp. 176–178.

Tests numerous compounds of copper as to their adhesive power when applied to the foliage of the potato as shown by analyses of treated leaves before and after submittal to artificial showers of rain. Concludes that Bordeaux mixture (2 kg. cop. sulphate and 1 kg. lime) adheres better than the same mixture with double amount of lime; that the copper soda mixture and copper acetate possess adhesive power double that of Bordeaux, and the Perret mixture (copper sulphate, lime, and molasses) showed remarkable adhesive properties, while Bordeaux mixed with clay (aluminium compounds) did not adhere so well as the standard Bordeaux. (D. G. F.) (See also Comp. Rend., Paris, Feb. 1, 1892, pp. 234–236; Exper. Sta. Record, vol. iii, May, 1892, p. 734.)

828. Goff, E. S. **Treatment of apple scab.** <Jour. Mycol., vol. vi, Washington, May 14, 1890, pp. 19–21.

Recommends solution of copper carbonate in ammonia and gives directions for preparing and using the fungicide. Also describes apparatus for spraying. (J. F. J.)

829. Goff, E. S. **Treatment of fungous diseases.** <Jour. Mycol., vol. vii, Washington, Sept. 10, 1891, pp. 17–25, fig. 2.

Gives details of experiments for the prevention of apple scab, using copper carbonate dissolved in ammonia and in suspension in water; sulphur powder, and mixture No. 5 (ammoniated copper sulphate and ammonium carbonate). The results were mostly negative, but mixture No. 5 was most efficient. Details of treatment of *Septoria* of raspberry and blackberry are given, and show that the foliage of the raspberry is too delicate to stand applications of a corrosive nature. Foliage of blackberry is more resistant than raspberry and less so than that of apple. Ammoniacal copper carbonate solution can be used on blackberry but not on raspberry. The use of Bordeaux mixture for potato rot was successful. (J. F. J.)

830. Green, W. J. **The spraying of orchards.** <Ohio. Agric. Exper. Station, 2d Ser., vol. 4, Bull. No. 9, Columbus, Dec., 1891, pp. 193–219, pl. viii–xiii, 1 diagram.

Gives an account of experiment to prevent apple scab undertaken to ascertain (1) compounds to be used; (2) time to make application; (3) compound best adapted to be used with insecticides, and (4) profit in spraying. Five fungicides were used, viz, ammoniacal copper carbonate, modified eau celeste, dilute Bordeaux mixture, precipitated carbonate of copper, and ammonia copper solution. Of these dilute Bordeaux mixture gave the best results. Gives details of relative efficacy of fungicides, cost of spraying, effect of scab on the fruit, value of spraying to prevent scab, size of apples as effected by spraying, market value of apples, time and machinery for spraying. Found Paris green and dilute Bordeaux mixture together acted as both fungicide and insecticide. Discusses also spraying to prevent pear scab, dilute Bordeaux mixture and modified eau celeste being about equally beneficial, but the latter

injured the foliage. For "shot-hole" fungus of the plum (*Septoria cerasina*) dilute Bordeaux mixture was found beneficial. Gives directions for making fungicides and a short list of manufacturers and dealers in spraying machinery. Gives a summary of the bulletin on last page. (See Exper. Sta. Record, vol. III, April, 1892, p. 620.) (J. F. J.)

831. GREINER, T. (1) **Comments on current agricultural literature.** (2) **The New York grape scare.** <Farm and Fireside, vol. XV, Springfield, Ohio, Dec. 15, 1891, p. 2.

(1) Thinks that Bordeaux mixture will soon "play out." It has various objections: (*a*) it is expensive; (*b*) it is troublesome to prepare and apply; (*c*) it has to be strained; (*d*) it is apt to clog the nozzle. Recommends the ammoniacal solution for all diseases. Advises fruit growers to study these questions so as to be prepared to spray in the proper way next year. (2) Says that grape growers were as much to blame as the New York Board of Health. The grapes should not have been sprayed so late, and if sprayed late the ammoniacal solution should have been used. (B. T. G.)

832. HALSTED, B. D. **Experiments for the year upon cranberry diseases.** <11th Ann. Rept. N. J. Agric. Ex. Sta., New Brunswick, 1891, pp. 332–339.

(1) Gives results of winter treatment of cranberry bog attacked by gall fungus (*Synchytrium vaccinii* Th.), showing good effects from keeping the bog dry. Gives copy of New Jersey State law for the eradication of dangerous plant diseases passed with special reference to the affected bog. (2) Gives results of several experiments with fungicides in the treatment of cranberry scald, using sulphur, sulphate of copper, sulphate of iron, air-slaked lime, common salt, carbonate of lime, modified eau celeste, sodium hyposulphate, sulphate of potash, ammoniacal solution of copper carbonate and Bordeaux mixture. Finds that heavy applications—1½ to 10 pounds of copper sulphate per square rod of bog, 3 to 20 pounds of iron sulphate, 3 to 20 pounds of sulphur—not only did not prevent disease but actually killed the vines, while mixed applications of sulphur and lime, sulphur and sulphate of copper, lime and sulphate of copper, and carbonate of lime, did not injure the vines in proportion of 2 to 10 pounds of each salt per 4 square rods of bog, but checked the scald only partially. Reports negative results from a test of ten substances named above in the proportion of 10–5–3½–1½ pounds per 25 square feet of bog. Reports a successful use by Mr. Goldsmith of layer of loam or sand applied to bog. (D. G. F.)

833. HALSTED, B. D. **Fungous diseases and their remedies.** <Amer. Agric., vol. LI, New York, Jan., 1892, pp. 34–35.

Briefly describes methods used for prevention of fungous diseases by spraying, soaking seed, etc. Gives credit to Department of Agriculture for work accomplished. (J. F. J.)

834. HALSTED, B. D. [**Remarks on spraying.**] <Ann. Rept. N. J. State Board of Agric., vol. XVIII, Trenton, 1891, pp. 100–102.

Advocates spraying for prevention of plant diseases. (J. F. J.)

835. HALSTED, B. D. **Treatment of grapevines.** <Cult. and Country Gent., vol. LVI, Albany, N. Y., July 16, 1891, p. 576.

Review of Farmers' Bulletin No. 4, of U. S. Department of Agriculture, giving directions for treatment of grape vines for prevention of downy and powdery mildew, anthracnose and black rot. (D. G. F.)

836. HARVEY, F. L. **Spraying experiments—apple scab.** <Ann. Rept. Maine Agric. Ex. Sta., part IV, Orono, Dec. 31, 1890, (1891), p. 113.

Mentions failure to carry out expected experiment with apple scab. (D. G. F.)

837. HATCH, A. S. [**Notes on apple scab and potato rot.**] <Jour. Mycol., vol. VII, Washington, Sept. 10, 1891, pp. 26–27.

Gives additional notes on the experiments conducted by Prof. Goff, mentioning effects of spraying on the foliage of apple, raspberry, and blackberry. Describes also manner of treating potatoes with Bordeaux mixture for blight. This was also effective against Colorado potato beetle. (J. F. J.)

838. HOWARD, CHAS. H. **Spraying fruit.** <Farm, Field, and Stockman, vol. XV, Chicago, Feb. 6, 1892, p. 127.

Notices a review of paper read before Illinois State Horticultural Society for 1892. Partially successful use of copper sulphate and soda in prevention of rot of grapes. (D. G. F.)

839. KELLERMAN, W. A., and SWINGLE, W. T. **Prevention of smut in oats and other cereals.** <Jour. Mycol., vol. VI, Washington, May 14, 1890, pp. 26–29.

Gives outline of treatment to be used. This is by means of hot water. (See for further details Nos. 156, 157, 291.) (J. F. J.)

840. KINNEY, L. F. **The potato scab.** <Rhode Island State Agric. Exper. Sta., Bull. 14, Kingston, Oct., 1891, pp. 175–187, figs. 3.

Gives an account of the characters and cause of the disease from Bolley and Thaxter, and details of experiments for its prevention. Seaweed used to cover the seed potatoes checked the disease, while stable manure scattered in the furrows or over the seed was favorable to its development. Spraying the seed in the furrows with Bordeaux mixture before covering with earth gave a product almost free from scab, and was more effectual than the sprayings of the vines with the same fungicide. Spraying with Bordeaux mixture also gave good results in the prevention of potato blight and rot. (See Exper. Sta. Record, vol. III, Apr., 1892, p. 623; Gard. Chron., London, June 11, 1892, p. 758.) (J. F. J.)

841. M[ARLATT], C. L. **A cheap spraying apparatus.** <Insect Life, vol. III, Washington, Aug., 1890, pp. 38–39, fig. 1.

Describes and figures an apparatus designed by R. Thaxter for using fungicides and insecticides. (J. F. J.)

842. MASSEY, W. F. **The Bordeaux mixture.** <Am. Farmer, 10th ser., vol. X, Baltimore, June 15, 1891, p. 137, ½ col.

Mentions use of Bordeaux mixture as a fungicide. (J. F. J.)

843. MAYNARD, S. T. **Treatment of mildews upon plants under glass.** <Jour. Mycol., vol. VI, Washington, Mar., 1890, pp. 16–18.

Gives summary of results of experiments on rose and lettuce mildew. For both recommends evaporated sulphur under proper conditions. (J. F. J.)

844. McCLURE, C. W. **Fungicides.** <Trans. Ill. State Hort. Soc., new ser., vol. XXV, Warsaw, Dec. 8–10, 1891, pp. 239–243.

Gives popular instructions for preparation and application of common fungicides. (D. G. F.)

845. MEEHAN, JOS. **Bordeaux mixture for pear blight.** <Cult. and Country Gent., vol. LVII, Albany, N. Y., Jan. 14, 1892, p. 28, ⅓ col.

Gives successful result from use of Bordeaux mixture for leaf-blight. Gives formula as 1 pound sulphate of copper, 1 pint ammonia to 22 gallons of water. This also used with success for black spot of roses. (J. F. J.)

846. [MEEHAN, T.] **Blackberry rust.** <Meehan's Monthly, vol. I, Germantown, Pa., Aug., 1891, p. 27, ⅓ col.

Notes presence of red rust on blackberry and raspberry leaves during summer at East Stroudsburg, Pa. Cutting out and burning recommended. (J. F. J.)

847. [MEEHAN, T.] **Bordeaux mixture.** <Meehan's Monthly, vol. II, Germantown, Pa., Jan., 1892, p. 10, ⅓ col.

Does not consider lime necessary in preparing Bordeaux mixture. (J. F. J.)

848. [MEEHAN, T.] **Sulphate of iron.** <Meehan's Monthly, vol. I, Germantown, Pa., Nov., 1891, p. 74, ⅓ col.

Refers to use of copper as a fungicide, stating that both sulphate of iron (green copperas) and sulphate of copper (blue copperas) are useful to destroy fungi. (J. F. J.)

849. MENOZZI, A. **Appunti alla comunicazione preventiva dei Proff. A. N. Berlese ed L. Sostegni "Osservazioni sull' idea di preservare la vite dall'invasione della Peronospora mediante la cura interna preventiva con sulfato di rame."** <Staz. Sperim. Agr. Italiene, vol. XXI, Nov., 1891 (Dec. 20, 1891), Asti, pp. 466–467.

Discusses article by Berlese and Sostegni in September number (see No. 801) expressing the opinion that the reaction taking place in the soil upon the addition to it of copper sulphate is not similar to that which takes place in case of the Bordeaux mixture, but more probably that the copper sulphate behaves like sulphate of potassium or sulphate of ammonium. Refers to work of Gorup Besanez (Ann. der Chem. u. Pharm., Bd. 127, p. 251) and Nobbe (Land. Vers. Stat., Bd. 15, p. 273), not mentioned by Berlese & Sostegni. (D. G. F.)

850. MILLARDET ET GAYON. **Nouvelles Observations sur l'efficacité de diverses bouillies dans le traitement du mildiou.—Sulfostéatite.**—<Journ. d'Agric. Prat., 56 année t. I. Paris, Feb. 18, 1892, pp. 231–239.

Gives results of experiments in treatment of *Peronospora viticola* in various localities in France testing the following fungicides: (1) Bouillie bordelaise céleste [principally sulphosaccharate of copper]; (2) Bouillie céleste à poudre unique [Sulphosaccharate of copper mixed with sulphate of copper and carbonate and bicarbonate of soda 2 kg. per hectolitre of water]; (3) Bouillie au sulphate d'ammonique [Bordeaux mixture; 1 kg. copper sulphate + 500 gr. lime + 400 gr. ammonium sulphate + 1 hectolitre of water]; (4) Bouillie bordelaise au sporivore Lavergne [Bordeaux mixture with addition of sporivore 1 kg. 500 gr. copper sulphate, 1 kg. 500 gr. lime, to which is added 1 kg. of sporivore, prepared by M. Lavergne, heated previously in 1 hectolitre of water]; (5) Bouillie bourguignonne [1 kg. 500 gr. copper sulphate, 2 kg. 250 gr. sodium carbonate crystals in 1 hectolitre of water prepared warm]; (6) Bouillie berichonne [same formula with addition of 25 centilitres ammonia 22 per cent]; and (7) ordinary Bordeaux [1 kg. 500 copper sulphate, 500 gr. lime in 1 hectolitre of water.] Although the results of the several experiments varied somewhat the author concludes that the mixtures containing a small amount of copper in solution as Nos. 1, 2, 3, and 6 gave no better results than those containing the copper in insoluble form. Reports from use of No. 3 serious injury to the foliage. Decides that the ordinary Bordeaux mixture using only 1 kilogramme of copper sulphate per 100 litre of water is not strong enough to prevent severe attacks of mildew. Closes with accounts of favorable results, obtained with use of sulphosteatite. (D. G. F.)

851. NESSLER, J. **Copper-soda and copper-gypsum as remedies for grape mildew.** <Jour. Mycol., vol. VI, Washington, Sept. 10, 1890, pp. 73–74.

Describes methods of preparing the solutions and recommends spraying rather than using a dry powder. (J. F. J.)

852. Parmly, J. C. **Copper solutions and soils.** <Cult. and Count. Gent., vol. LVII, Albany, N. Y., Mar. 10, 1892, p. 184, ⅔ col.

Refers to article by S. A. Beach (see No. 800) and advocates use of sawdust or some similar material to catch the poisonous substances used in spraying. (J. F. J.)

853. Penny, C. L. **Several articles of food known to be healthful found to contain small quantities of copper.** <2d Ann. Rept. Del. College Agr. Ex. Sta., Newark, 1889, pp. 172–174.

Establishes presence of copper in grapes that have been treated with Bordeaux mixture and afterward washed with dilute vinegar, as also in grapes receiving no treatment, *i. e.*, natural; gives analyses of molasses, oatmeal, flour, beef liver, and New Orleans syrup. The number of parts of copper per million varies from 0.86 in flour to 58.85 in beef liver. Treated grapes contain from 2.4 to 6.23 parts per million, an amount little exceeding that in baking molasses or oatmeal, and less than one-ninth that found in beef liver. (D. G. F.)

854. Rathay, Emerich. **Bericht über eine im hohen Auftrage Seiner Excellenz des Herrn Ackerbau Ministers in Frankreich unternommene Reise zur Nachforschung über die Rebkrankheit Black Rot.** <Wien, 1891, pp. 20, fig. 7.

Gives a report of a visit made by the French Minister of Agriculture and several scientists to southern France in order to investigate the black rot fungus. The vines near Val Marie were first examined, this being the place where black rot was first discovered in France. Despite the most energetic efforts by the Government extending over a period of five years the disease still exists in this region. The report concludes by saying that black rot occurs sporadically throughout southern France, that no satisfactory remedy for it has been found, and that owing to its affecting green wood, its transportation on half-matured cuttings is made highly probable. (B. T. G.)

855. Riley, C. V. **The outlook for applied entomology.** <Insect Life, vol. III, Washington, Jan., 1891, pp. 181–210.

Although devoted mainly to entomology, mention is made (pp. 192–195) of machines for using fungicides and insecticides, among them the Japy and Galloway sprayer and the Strawsonizer. Reference is also made (pp. 197–198) to contagious diseases of insects, the statement being that the best results so far obtained have been with the *Entomophthora* of the chinch bug. Gives brief mention of method of studying these diseases. (J. F. J.)

856. [Roosevelt, George W.] **[Experiment on potatoes in Belgium.]** <Report of Statistician U. S. Dept. of Agric., new ser., No. 92, Washington, Jan. and Feb. [Feb. 12], 1892, p. 27.

A quotation from a report by Consul Roosevelt mentioning successful use of Bordeaux mixture in combating potato rot. The plat treated yielded 21,500 kilograms to the hectare, while that untreated yielded only 6,900 kilograms to the hectare. (J. F. J.)

857. Rostrup, E. **Destruction des cryptogames nuisibles.** <Rev. Mycol., vol. XIV, Toulouse, Jan. 1, 1892, pp. 29–33.

Divides injurious fungi into two classes—one which can be controlled by the individual farmer independently of his neighbors, and another which requires concerted action to eradicate. In the first class the author includes smuts of grain, *Plasmodiophora brassicæ*, *Rhizoctonia violacea*, *Sclerotinia trifoliorum*, and *Phoma sanguinolenta*. In the second class are *Phytophthora infestans* and the *Uredineæ*. For the latter he recommends legislation which shall have for an end the disinfection of seed, destruction of hosts which produce any form of rust that will infect economic plants, and the hindrance to the introduction of fungous diseases by plants or seeds from countries where diseases exist. (E. A. S.)

858. S[mith], H. W. **Mixtures for grape diseases.** <Am. Gardening, vol. XIII, New York, Feb., 1892, p. 114, ½ col.

Gives formulæ for Bordeaux mixture and ammoniated copper carbonate solution. (J. F. J.)

859. [Smith, H. W.] **Prevention of plum knot.** <Am. Gardening, vol. XIII, New York, Feb., 1892, p. 116. ½ col.

Recommends cutting out diseased branches. Spraying with ammoniacal solution may check disease. (J. F. J.)

860. [Smith, H. W.] **Rose mildew.** <Am. Gardening, vol. XIII, New York, Feb., 1892, p. 115, ½ col.

Recommends as a preventive ½ ounce hyposulphite of soda to 10 gallons water; ammoniacal solution of copper carbonate also recommended. (J. F. J.)

861. Stahl, John M. **Spraying in western Illinois.** <Cult. and Country Gent., vol. LVI, Albany, Sept. 3, 1891, p. 716, 2 cols.

Gives popular account of successful use of remedies against grape diseases by the Nauvoo Fruit Growers' Association. (D. G. F.)

862. Stahl, Wm. **Black rot and mildew.** <Fla. Disp., Farmer and Fruit Grower, new ser., vol. III, Jacksonville, Jan. 8, 1891, p. 25, 3 cols.

Extract from circular of manufacturers of spraying machinery. (D. G. F.)

863. Stebbins, C. W. **Pear blight.** <Fla. Disp., Farmer and Fruit Grower, new ser., vol. IV, Jacksonville, Mar. 3, 1892, p. 163, ½ col.

Says blight was cured by sprinkling tree with copperas and water, a tablespoonful to a bucket of water. Some also put on ground and hoed in. (Quoted from "National Stockman.") (J. F. J.)

864. SWINGLE, W. T. **Treatment of smuts of oats and wheat.** <U. S. Dept. Agric., Div. of Veg. Path., Farm. Bull. No. 5, Washington, Feb., 1892, pp. 8, pl. 1.

Describes the smuts of grain and gives an estimate of amount of damage resulting from the diseases. Gives directions for treatment, consisting mainly of immersing seed in hot water at a temperature of 132° to 135°. This is known as the Jensen treatment. Potassium sulphide for oats and copper sulphate for wheat also noticed. Short bibliography given on p. 8. (See also Agric. Jour. Cape Colony, vol. v, May 5, 1892, pp. 3–5.) (J. F. J.)

865. VAN SLYKE, L. **Results of analyses of some substances used in spraying.** <Cult. and Country Gent., vol. LVII, Albany, N. Y., Feb. 18, 1892, p. 128, 1 col.

States that a can of "Copperdine" contained only 8¾ oz. of copper sulphate, equal to 4 oz. copper carbonate and 28 oz. ammonium carbonate. Cost was about 29 cents. A sample of dry Bordeaux contained 11.62 per cent of copper instead of 15.24 per cent, as it should have done. Gives tests for determining the purity of copper sulphate, copper carbonate, and Paris green. (J. F. J.)

866. VAN SLYKE, L. **The adulteration of copper mixtures.** <Gard. and Forest, vol. V, New York, Feb. 24, 1892, pp. 90–91.

A summary of conclusions given in a paper read before the Western New York Horticultural Society, mentioning tests for determining purity of various fungicides. (J. F. J.)

867. WARNER, CLARENCE D. **Electricity in agriculture.** <Science, vol. XIX, New York, Jan. 15, 1892, pp. 35–37.

Refers to the experiments made to show the influence of electric currents upon the growth of plants. Gives details of experiments made at Hatch Experiment Station, Amherst, Mass., on lettuce to ascertain effects of an electric current on prevention of mildew. The result was that the largest heads were over the greatest number of wires and nearest the electrodes; five out of fifteen died of mildew in treated bed. It was found that the healthiest and largest plants, as soon as the current became feeble or ceased altogether, began to be affected with mildew. In beds without electric currents only three plants out of fifteen had partially developed, and only one was free from disease. In another experiment only five out of twenty plants were unaffected by mildew in the treated bed, while out of twenty plants in an untreated bed all but one died from mildew before half grown, and that one was badly diseased. The conclusion is that "those plants subjected to the greatest electrical influence were hardier, healthier, larger, had a better color, and were much less affected with mildew than the others." Grasses were experimented with, but without marked results. (See also, Bull. No. 16, Mass., Hatch Ex. Sta., Jan., 1892, pp. 8; Scient. Am. Supplement, vol. XXX, Feb. 13, 1892, pp. 13436–13437; Am. Agric., vol. LI, Mar., 1892, p. 201, ½ col.; Exper. Station Rec., vol. III, Washington, Mar., 1892, pp. 517–520; Gard. and Forest, vol. V, Jan., 27, 1892, pp. 47–48.) (J. F. J.)

868. WEED, C. M. **Spraying crops: Why, when, and where.** <Rural Publishing Co., New York, 1892, pp. 108, illustrated.

Brief directions for combating some common insect and fungous pests. (B. T. G.)

(See also, Nos. 665, 670, 673, 684, 696, 697, 698, 703, 704, 706, 707, 710, 716, 717, 719, 720, 721, 723, 724, 726, 729, 734, 739, 740, 742, 743, 744, 746, 748, 750, 751, 754, 755, 756, 757, 761, 766, 770, 774, 775, 777, 778, 780, 871, and 885.

E.—PHYSIOLOGY, BIOLOGY, AND GEOGRAPHICAL DISTRIBUTION.

869. ACLOQUE, A. **Les champignons au point de vue biologique, economique et taxonomique.** <Paris, 1892, pp. 327, figs. 60.

The book is divided into thirteen chapters, the first of which treats of the nature of fungi. Chapters 2, 3, and 4 discuss anatomy, and 5, 6, 7, 8, and 9 deal with physiology of the fungi. In the tenth, eleventh, and twelfth chapters fungi from an economic standpoint are considered. The thirteenth and last chapter is devoted to classification, the systems of Tournefort, Micheli, Bulliard, Persoon, Link, Nees, Fries, and Léveille being briefly reviewed. Berkeley's system receives considerable attention, while Bertillon's is given in full. (B. T. G.)

870. [ANON.] **Parasitic fungus on locust.** <Mediterranean Nat., vol. I, Malta, Aug. 1, 1891, p. 44, ½ col.

Refers to experiments of Signor Trabut in Algiers, where *Botrytis acridiorum* has been found to destroy great numbers of locusts. Experiments are being made with a view of cultivating the parasite. (J. F. J.)

871. [ANON.] **Procès-verbaux, séance du 10 mai 1891.** <Ann. Soc. d'hort. et d'hist. nat. de l'Hérault, 2 sér., tome XXIII, Montpellier, May and June, 1891, p. 129.

MM. Sahut, Cathala, Barthélémy, Cachet, Ganzy, and Giardin were unanimous in declaring that abrupt variations of temperature are very favorable to the spread of the peach curl, *Exoascus deformans* Berk. M. Sahut stated that three methods of prevention had been tried, the Bordeaux mixture, decoctions of tobacco, and removal of the affected leaves. None of them were very successful. In 1890 the grape mildew (*Peronospora*) was not observed during the summer, and from May to September there was also an almost complete absence of dew. On the contrary, during September dew occurred on twelve days and there was an invasion of mildew. M. Galzin had found carbonate of soda better than lime for fixing copper sulphate. (E. F. S.)

872. BOARDMAN, E. R. **The cabbage worm disease.** <Insect Life, vol. III, Washington, June, 1891, pp. 409–410.

Gives account of spread of disease "Muscardine," destroying worms infecting cabbages. (J. F. J.)

873. BOLLEY, H. L. **Wheat rust—is the infection local or general in origin?** <Agric. Science, vol. V, Nov. and Dec., 1891, La Fayette, Ind., pp. 259–264.

Gives result of inquiries and details of experiments made to ascertain whether wheat rust mycelium persists in the tissues of host plants through the winter, and at what time the rust appears on the grain. Does not think spraying will be effectual in preventing rust. The uredospores are the chief agents of infection and may be carried for miles through the air without loss of vitality, and the general infection of fields throughout the country is thus accounted for. (J. F. J.)

874. BOURQUELOT, EM. **Matières sucrées contenues dans les champignons.** <Bull. Soc. Mycol., France, vol. 7, fasc. 4, Paris, Dec. 31, 1891, pp. 222–232.

Mannite was found in the following: *Psalliota arvensis* Schæff., young; *Tricholoma album* Schæff., adult; *T. sulfureum* Bull., young, adult; *T. resplendens* Fr., adult; *Lepiota excoriata* Schæff., young; *Hydnum repandum* L., young, adult; *H. squamosum* Schæff., adult; *Clavaria pistillaris* L., adult; *C. formosa* Pers., young. Trehalose was found in the following: young, *Hypholoma elæodes* Paul., *H. capnoides* Fr., *Stropharia æruginosa* Curt., *Flammula alnicola* Fr., *Hebeloma sinapizans* Fr., *H. crustuliniforme* Bull., *Claudopus variabilis* Pers., *Pleurotus ostreatus* Jacq., *Mycena polygramma* Bull., *M. galericulata* Scop., *Collybia longipes* Bull., *Clitocybe inversa* Scop., *C. geotropa* Bull., *Tricholoma cinerascens* Bull., *Lepiota excoriata* Schæff., *Amanita strobiliformis* Vitt., *A. nitida* Fr., *Bolbitus hydrophilus* Fr., *Coprinus micaceus* Bull., *C. atramentarius* Bull., *Cortinarius obtusus* Fr., *C. imbutus* Fr., *C. psammocephalus* Bull., *C. armillatus* Fr., *C. torvus* Fr., *C. cinnamomeus* L., *C. sublanatus* Sow., *C. elatior* Fr., *C. cærulescens* Schæff., *C. glaucopus* Schæff., *C. variicolor* Pers., *C. cyanopus* Secret., *C. crocolitus* Quel., *C. argutus* Fr., *Hydnum repandum* L. (E. A. S.)

875. BOURQUELOT, EM. **Sur la présence de l'amidon dans un champignon appartenant à la famille des Polyporées, le Boletus pachypus, Fr.** <Jour. Pharm. et chimie, 5e sér., t. XXIV, Paris, Sept., 1891, pp. 197–199.

Reports presence in the cells of the pseudoparenchyma of *Boletus pachypus* of a substance which gives starch reaction with iodine. This substance appears to be in an insoluble state apparently as an impregnation of the membrane. Refers to work of Belzung and L. Rolland on the subject. (D. G. F.)

876. BOURQELOT, EM. **Sur la répartition des matières sucreés dans le cèpe comestible (Boletus edulis, Bull.) et le cepe orangé (Boletus aurantiacus, Bull.).** <Jour. Phar. et Chimié, 5e sér. t. XXIV., Paris, Dec. 15, 1891, pp. 521–524.

Gives analyses of stipe, pileus and tubes of the hymenium of *Boletus aurantiacus* Bull. and *B. edulis* Bull. Finds that the stipe and pileus of these species alone contain the starch glucose or *mannite*, while the tubes of the hymenium remain free from these reserve materials. Reasons that these reserve materials are not present in this portion because consumed in the manufacture of the spores. Thinks this also explains the absence of dipterous larvæ from the hymenium. Refers to previous work on subject. (See ser. 5, t. XIX, p. 369; t. XXII, 413, 497. (D. G. F)

877. BREFELD, OSCAR. **Recent investigations of smut fungi and smut diseases.** <Jour. Mycol., vol. VI, Washington, May 14, 1890. pp. 1–8; Sept. 10, 1890, pp. 59–71; April 30, 1891, pp. 153–164.

A translation of an address delivered in Berlin before the Society of Agriculturists in February, 1888. Deals with the nature of parasites causing smut, their mode of development, methods of cultivation, manner of infection, and general life history. (J. F. J.)

878. CAVARA, F. **Note sur le parasitisme de quelques champignons.** <Rev. Mycol., vol. XIII, Toulouse, Oct., 1891, pp. 177–180.

Cites the following instances of fungi, which usually live as saprophytes, becoming parasitic to such an extent as to be decidedly injurious to vegetation: *Botrytis vulgaris* on branches of *Citrus*, *Dahlia*, and *Pelargonium zonale*; *Botrytis* n. sp. on *Tulipa gesneriana*; *Cladosporium herbarum* on raspberry, *Cycas revoluta*, *Fourcroya gigantea*, *Agave americana*, *A. salmiana*, and *A. rigida*; *Polyporus ulmarius* on elm roots. (E. A. S.)

879. CHARRIN, A. **La nature des sécrétions microbiennes.** <Rev. Gén. Sci. pure et appliq., 2 ann., Paris, Mar. 15, 1891, pp. 129–134.

General discussion of the subject. (E. F. S.)

880. CONSTANTIN, J. **Étude sur la culture des basidiomycètes.** <Rev. Gén. d. Bot., t. 3, Paris, Dec. 15, 1891, pp. 497–511, pl. 1.

After discussing in a general way the well-known methods of ancient and modern mushroom culture the author gives the results of his investigations upon the cultivation in nutrient media of *Nyctalis lycoperdoides* and *Marasmius oleæ*. Succeeded in producing from chlamydospores fully developed specimens of *Nyctalis*, with mature basidia, in this regard surpassing Brefeld in his cultivations of the same species. Uses as nutrient substrata upon which to grow the first species sterile slices of potato dipped in orange juice, slices of carrot, slices of turnip, leaves of the oak and beech, and fragments of other basidiomyceteous fungi. Finds the behavior of *Nyctalis* upon various substrata as indicative of the uncertain ground upon which *N. caliginosa*, *N. nauseosa*, and *N. microphylla* stand and reports the variation under different conditions of nourishment as very great. Finds, contrary to Brefeld, that spores of *Nyctalis* germinate easily upon the most diverse media and the parasitism of the species hinted at by Brefeld is made doubtful. In the cultivation of *Marasmius* the author used sterilized olive leaves and obtained pure spores by allowing basidiospores to fall in small glass plates filled with sterile water placed beneath the pileus. Suggests possible application of pure artificial cultures to the industry. (D. G. F.)

881. DEARNESS, J. **Poisoning from eating fungi.** <Farmers' Advocate, vol. XXV, London, Ont., p. 216, fig. 1.

Gives full account of a fatal case of poisoning attributed to eating of *Helvella esculenta* (Fries). This species has hitherto been considered edible by Berkeley, Gilbert, Burnett, and Julius Parmer. While author thinks it is not clearly proven that the species is poisonous he decides it is unfit for use. (D. G. F.)

882. DEVAUX, HENRI. **Étude expérimentale sur l'aération des tissus massifs: Introduction à l'etude du mécanisme des échanges gazeux chez les plantes aériennes.** <Ann. Sci. Nat. Bot., sér., VII, vol. XIV, Paris, 1891, pp. 297–395, fig. 5.

In course of his extended investigations the author examined the common edible agaric *Psalliota campestris*. There is easy communication through the internal tissues, but the exterior is only slightly porous. The composition of the internal gas differed only slightly from the atmosphere, but varied somewhat from time to time. The proportion of oxygen may fall below 16 in 100. Seven analyses are given, and analogous results are said to have been obtained with another subject. The examination was made before the pileus was developed. (E. F. S.)

883. [EDITORIAL.] **A novel mode of using disease germs.** <Insect Life, vol. IV, Washington, Nov., 1891, p. 152.

Gives abstract of a circular of a French firm advertising for sale culture tubes for the destruction of the white grub. States methods recommended. (J. F. J.)

884. [EDITORIAL.] **Work in Algeria with a fungous disease of the locust.** <Insect Life, vol. IV, Washington, Nov., 1891, pp. 151–152.

Abstract of a paper by Künckel and Langlois on a disease caused by *Lachnidium acridiorum* n. sp. The experiments are not encouraging. (J. F. J.)

885. EYCLESHEIMER, A. C. **Club root in the United States.** <Jour. Mycol., vol. VII, No. 2, Washington, Mar. 10, 1892, pp. 79–80, pl. XV, XVI, figs. 2.

Discusses the distribution and general characters of the disease. This is followed by a detailed statement of the effect of the disease on the tissues of various plants, particularly cabbages and turnips. There is no known cure after the disease is established, but preventive measures may be effectual. Of all means tried lime seems to be the best. Sterilization of the soil of the hotbed is also recommended. A short bibliography is given at the end of the paper. (J. F. J.)

886. FORBES, S. A. **On a bacterial insect disease.** <Amer. Month. Micros. Jour., vol. XII, Washington, Nov., 1891, pp. 246–249.

Describes disease affecting chinch bugs, caused by *Micrococcus insectorum* Burr. No success has been met with in attempting to inoculate insects with the disease, because all examples examined were infected with the *Micrococcus* in question. (J. F. J.)

887. FRIES, ROB. **Om svampfloran i våra växthus.** <Bot. Notiser, Lund, 1891, pp. 145–157.

Fungi arranged in three groups: (1) Species which, under natural circumstances, are living in open air, but which accidentally may also occur in hothouses, often with a somewhat changed habit and appearance. (2) Species which *par préference* are inhabitants of hothouses, and which do not occur in other places at least not in Sweden. (3) Species which have been accidentally introduced from southern lands. The second group includes several interesting species, most of which occur in great abundance, such as *Lepiota cepæstipes*, *Agaricus echinatus*, *A. volvaceus*, *A. parvulus*, *A. confertus*, *Polyporus cryptarum*, *Coprinus dilectus*, *Discina vaporaria*, and *Hydnangium carneum*. But very few species are mentioned as representing the 3d group *e. g.* *Hiatula benzonii*, *Agaricus geoglerius*, *Laschia testudinella*. (Theo. Holm.)

888. GALLOWAY, B. T. **Observations on the life history of Uncinula spiralis.** <Proc. Am. Asso. Adv. Sci., vol. XXXIX, July, 1891, Salem, Mass., p. 333, 3 lines.

Abstract (see No. 132). (J. F. J.)

889. GALLOWAY, T. W. **Notes on the fungus causing damping off and other allied forms.** <Trans. Mass. Hort. Soc., Part 1, Boston, 1891, pp. 10, pl. 2.

Records interesting observations on *Pythium debaryanum* and *Saprolegnia monoica* made in the cryptogamic laboratory, Harvard University. (B. T. G.)

890. GIARD, A. **Sur le champignon parasite des criquets pèlerins.** <Compt. rend. Acad. d. Sc., Paris, Dec. 7, 1891, pp. 813–816.

The author says that Prof. H. Trabut has found that *Lachnidium acridiorum* Giard is identical with the fungus found in different parts of Algeria on the same host. Older cultures of the fungus furnish evidence as to its systematic position. On the insects themselves it presented two different forms, designated *Cladosporium* and *Fusarium*, or *Fusisporium*. In young cultures the latter predominates. When the cultures become older chlamydospores make their appearance. From this time parts of the fungus pass through stages closely resembling the genera *Sarcinella*, *Stemphylium*, *Macrosporium*, and *Mystrosporium*. *Cladosporium herbarum* also passes through similar stages, and it is probable that the two fungi are closely related. It is also likely that the genera represented in the transformations are really not independent genera, but stages in the development of some Ascomycete. The *Lachnidium* closely resembles the *Fusarium* on violet leaves and chestnut trees. (E. A. S.)

891. Gosio, B. **Action of microphytes on solid compounds of arsenic; a recapitulation.** <Science, vol. XIX, New York, Feb. 19, 1892, pp. 104–106.

A paper on the poisonous products derived from wall papers containing arsenic. Gives methods used to ascertain whether the arsenical vapors are due to the presence of parasitic molds (*Mucorini.*) By means of pure cultures of *Penicillium glaucum*, *Aspergillus glaucus*, and *Mucor mucedo*, it was found that the two latter, and more especially the last, gave rise to arsenical gas when grown in arseniated culture media. Experiments led to the conclusions: (1) that the Mucor grew vigorously in media containing considerable quantities of arsenic; (2) that many solid compounds of arsenic give off gases through the activity of the fungus which vegetates in contact with them; (3) this evolution of gas is constant and lasting in case of oxygen compounds of arsenic, including arsenite of copper; (4) in certain conditions of humidity, temperature, and light, arsenical gases are given off from hangings colored with Scheele's and Schweinfurth's green, through the vegetation of the *Mucor*, and there is danger in breathing these exhalations. (J. F. J.)

892. H., * * * G. **Suspicious fungi.** <Cult. and Count. Gent., vol. LVII, Albany, N. Y., Mar. 10, 1892, p. 187, ⅕ col.

Queries whether corn smut has any poisonous effect on cattle or whether two or three months in the silo would tend to destroy its vitality. Notes the disappearance of ergot from rye fields in recent years. (J. F. J.)

893. Halsted, B. D. **Autumn leaves disperse their molds.** <Am. Agric., vol. L, New York, Dec., 1891, p. 700, ⅓ col.

Refers to the distribution of fungous spores over wide areas by means of the wind. (J. F. J.) (See Kansas Weekly Capital, Topeka, May 5, 1892.)

894. Kienitz-Gerloff, F. **Die Protoplasmaverbindungen zwischen benachbarten Gewebeselementen in der Pflanze.** <Bot. Zeit., Jahrg. 49, Leipzig, Jan. 2, 9, 16, 23, 30, 1891, pp. 1–10, 17–26, 33–46, 49–60, 65–74, pl. 2.

The paper deals mostly with the continuity of protoplasm in higher plants, but on p. 66 the implication is made that parasitic fungi obtain their nourishment from the host cell by secreting a diastase-like ferment. On p. 67 the author proposes the theory that the fungus hyphæ in lichens obtain their nourishment from the algæ cells by secreting an enzyme. Thinks protoplasmic connections may be found between the neighboring cells of fungi when not all the cells are equally engaged in absorbing nourishment. Further states that their presence is rendered more probable from the fact that pits have been observed in the hyphæ of *Hymenomycetes*. (W. T. S.)

895. Lagerheim, G. de. **The relationship of Puccinia and Phragmidium.** <Journ. Mycol., vol. VI, Washington, Jan. 6, 1891, pp. 111–113.

Gives differences usually stated as occurring between the two genera, especially in the teleutospores and uredospores, examining various species. Concludes there are points of resemblance between numerous species of the two genera. (J. F. J.)

896. Moult, M. Le. **Le parasite du hanneton.** <Compt. rend. Acad. d. sc., vol. CXIII, Paris, Aug. 3, 1891, pp. 272–274.

The author states that he has prepared cultures of the parasite on a large scale and urges the necessity of combating the beetle by infecting the soil before the transformation of the larva occurs. Has found spores produced both on the external mycelium and within the body of the larva, filling the latter with a whitish powder. Culture tubes infected with both kinds of spores and with parts of the body of a mummified larva have given identical results, the fungus produced having the same characters as that on the worm. (E. A. S.)

897. Osborn, Herbert. **On the use of contagious diseases in contending with injurious insects.** <Insect Life, vol. III, Washington, Nov. 1, 1890, pp. 141–145.

Refers in a general way to the various diseases of insects, some of which are caused by fungi, and to the difficulties in their study. Gives an account of an attempt to introduce a disease of cabbage worms caused by a species of *Micrococcus*. Believes the disease may be transferred from place to place, but that it spreads very slowly and the final results are uncertain. (J. F. J.)

898. Pearson, A. W. **Constitutional health of plants.** <Gard. and Forest, vol. V, New York, Mar. 9, 1892, p. 118, 1¼ col.

Notes that at times the spores causing black rot destroy certain varieties of grapes and not others. The Ives is at times exempt when the Concord is destroyed. Queries whether antidotes for certain diseases might not be supplied plants through their absorptive systems. Healthy plants are better able to resist attacks of disease and when attacked are more likely to recover. An instance of this is given from the potato. (J. F. J.)

899. Pearson, A. W. **The constitutional health of plants.** <Gard. and Forest, vol. V, New York, Mar. 16, 1892, pp. 130–131, 1½ col.

Gives results of experiments with nitrate of soda as a preventive of strawberry leaf-blight. Considers that the immunity from disease was due to vigorous growth and the stimulating effect of nitrate. Pruning pear trees by stimulating growth prevented attacks of leaf-blight and cracking due to *Entomosporium maculatum*. (J. F. J.)

900. Riley, C. V. **Applied entomology in the United States.** <Am. Agric., vol. LI, New York, Jan., 1892, pp. 38–40.

Refers incidentally to use of fungous germs for destruction of insects. (J. F. J.)

901. ROSEN, F. **Bemerkungen über die Bedeutung der Heterogamie für die Bildung und Erhaltung der Arten im Anschluss an zwei Arbeiten von W. Burck.** <Bot. Zeit., 49 Jahrg., Leipzig, Mär. 27., 1891, pp. 201–211, April 3, 1891, pp. 217–226.

Author considers the following works by W. Burck, "Ueber Kleistogamie im weiteren Sinne und das Knight-Darwin'sche Gesetz" (Annales du Jardin Botanique de Buitenzorg, vol. VII, pp. 122–164, taf. 4) and "Eenige bedenkingen tegen de theorie van Weismann aangaande de beteekenis der sexueele voortplanting in verband met de wet van Knight-Darwin" (Natuurkundig Tijdschrift voor Nederlandsch Indië, Diel XLIX (achtste serie, diel X, pp. 501–544, pl. I). Discusses the importance of cross-fertilization in plants and also Weismann's theory that variability depends on sexual reproduction. Most of the article discusses phanerogams, but on p. 225 he adduces the alga-like fungi as an example of plants which have sexual propagation and *Basidiomycetes* as example of a variable group, rich in species, which propagate exclusively by asexual means. Mentions that these fungi are chemically and histologically much differentiated. Mentions Uredineæ as progenitors of Basidiomycetes. Opposes the Knight-Darwin law and Weismann's theory. (W. T. S.)

902. SNOW, F. H. **Experiments for the destruction of chinch bugs in the field by the artificial introduction of contagious diseases.** <Insect Life, vol. III, Washington, Mar., 1891, pp. 279–284.

Gives details of experiments made in 1889 and 1890 to spread an infectious disease. Three diseases were noticed, one caused by *Entomophthora* or *Empusa*, one by a *Micrococcus*, and the third by a species of *Isaria* or *Trichoderma*. Numerous letters are quoted giving details of success of the work. (J. F. J.)

903. STOLLER, JAS. H. **Studies in plant biology. II.—The green mold.** <Pop. Science News, vol. XXV, Boston, Mar., 1891, pp. 33–34, 2 cols.

Describes briefly in popular language the biology of *Penicillium glaucum*. (D. G. F.)

904. STRATON, C. R. **The value of attractive characters to fungi.** <Science Gossip, No. 314, London, Feb., 1891, pp. 44–45.

Quotation of an article in "Nature," noticing the colors and odors of fungi, and advancing the idea that these are characters for attracting insects and animals to aid in the multiplication of the species. Says it is necessary for spores of *Agaricus campestris* to pass through the bodies of animals before they will germinate and produce mycelial threads. Believes this to be the case with other species also. (J. F. J.)

905. VAN BREDA DE HAAN, J. **Les Expériences de M. Beyerinck sur les Bactéries lumineuses et leur nutrition.** <Rev. géné. sci. pure et appli., 2e ann., Paris, Feb. 15, 1891, pp. 81–82.

Paper based partly on memoirs in *Archives néerlandaises des sciences exactes et naturelles*, tome XXIII, and partly on unpublished data furnished by the author. Six species of Photobacterium are distinguished, *Ph. phosphorescens*, *indicum*, *luminosum*, *balticum*, *fischeri*, and *pflugeri*. The first renders fish phosphorescent, the second is found in the waters of the Indian Ocean, the third on the coasts of Holland, and the others in the Baltic Sea. Beyerinck's culture methods are described, and especially a new method called auxanographie, whereby he is able to study the exact effect of nutrient substances simply or in combination. The phosphorescence can be produced or eliminated at will without destruction of the organisms, and is believed to be an accidental consequence of internal chemical processes. Different forms can be separated by their behavior toward diastases. Recently these photobacteria have been used to show that the Chamberland filter is germ-proof. (E. F. S.)

906. VAN TIEGHEM, M. D. **Prix Montagne (Commissaires: MM. Duchartre, Trécul, Chatin, Bornet; Van Tieghem, rapporteur).** <Compt. rend. Acad. d. sc., vol. CXIII, Paris, Dec. 21, 1891, pp. 920–922.

Notes the granting of this academic prize to Henri Jumelle for a manuscript memoir entitled, *Recherches physiologiques sur les Lichens*. This investigation was carried on in the laboratory of vegetable biology instituted by the faculty of sciences of Paris in the forest of Fontainebleau. M. J. devoted himself especially to the study of the exchange of gases taking place between lichens and the air under varying degrees of light, humidity, and heat. In obscurity both components of the lichen respire, and the respiratory quotient $\frac{CO_2}{O}$ is always less than unity, about 0.8 oxygen is fixed. In light, the assimilation of carbon, exclusively through the chlorophyll of the alga, predominates over respiration, although the latter continues in both alga and fungus. This predominance varies greatly according to the species and is less noticeable in proportion as the alga occupies less space. In fruticulose and foliaceous lichens it is strong and very noticeable even in diffused light. In crustaceous lichens it is feeble and only manifest in the sun. In all cases the quotient of assimilation $\frac{O}{CO_2}$ is greater than one and may rise to 1.5, 1.6, or even 1.8, a part of the liberated oxygen is therefore borrowed from some other source than the carbon dioxide of the air. Fruticulose and foliaceous lichens contain relatively little water, at most only four times their dry weight, and can not lose this without injury. Gelatinous lichens contain much water, even twenty-four times their dry weight, and can lose it all without injury. Moistened after complete drying they again take up the normal exchange of gases. Lichens bear great variations of temperature without injury. They are unchanged after three days at 45° C., after fifteen hours at 50°, after five hours at 60°. At these temperatures their respiration continues normal, but assimilation ceases after one day at 45°, three hours at 50°, and thirty minutes at 60°. Elevated temperatures therefore suppress the assimilation of carbon without diminishing the respiration—*i. e.*, change the alga without affecting the fungus. Lichens also resist very low temperatures, even below —40°. At —10° respiration is very feeble; at —20° it ceases entirely. On the contrary, the assimilation of carbon not only continues at

these temperatures, but also at much lower ones, even −40°, when, by the freezing of a part of its water of constitution, the lichen has taken the consistency of a block of ice. Low temperatures therefore stop respiration while permitting the assimilation of carbon—*i. e.*, they affect the fungus and not the alga. By reason of the double constitution of lichens these two sorts of gaseous exchange which go on simultaneously in green plants in light can be separated by the action of heat, respiration only, carried on by the fungus, persisting at high temperatures and assimilation only, carried on by the alga, persisting at low temperatures. (E. F. S.)

907. WEBSTER, F. M. **A podurid which destroys the red rust of wheat.** <Insect Life, vol. II, Washington, Jan.–Feb., 1890, pp. 259–260.

Records a species of Neuropter (*Smynthurus*) feeding on uredospores of wheat rust (*Puccinia rubigo-vera*). While the spores eaten are destroyed, the hairs on the body of the insects serve to convey other spores from one plant to another and thus aid in distributing it. (J. F. J.)

See also Nos. 661, 721, 724, 732, 760, 769, 854, 933, and 939.)

F.—MORPHOLOGY AND CLASSIFICATION OF FUNGI.

I.—GENERAL WORKS.

908. BAILEY, F. M. **Botany: Contributions to the Queensland flora.** <Dept. of Agri. Queensland, Bull. No. 9, Brisbane, May, 1891, p. 32.

Gives description of *Glœosporium pestiferum* Cke. & Mass., as occurring in the colony. (J. F. J.)

909. BAILEY, F. M. **Contributions to the Queensland flora.** <Dept. Agric. of Queensland, Bull. No. 13, Brisbane, Dec., 1891, pp. 39, pl. 6.

Under fungi (pp. 36–38) gives list of species found with descriptive notes. No new species. (J. F. J.)

910. BORNET, M. **Prix Desmazieres (Commissaires: MM. Duchartre, Van Tieghem, Chatin. Trécul; Bornet, rapporteur).** <Compt. rend. Acad. d. sci., vol. CXIII, Paris, Dec. 21, 1891, pp. 918–920.

Notes the conferring of this Academic prize on A. N. Berlese for meritorious work in Mycology, especially for three important publications. (1) A monograph of the genera *Pleospora*, *Clathrospora*, and *Pyrenophora*, forming a volume of 260 pages, accompanied by 12 colored plates, representing 111 species; (2) *Icones Fungorum ad usum Sylloges Saccardianæ accomodatæ*, of which great enterprise two parts illustrating Pyrenomycetes have been issued; (3) *Fungi moricolæ*, a volume containing 200 pages and 71 colored plates designed and lithographed by the author, and in which he has doubled the number of fungi known previously to occur on the mulberry, and brought out various other interesting facts, *e g.*, that the fungous flora of the mulberry is quite different from that of the olive, but related to that of the elm and *Brousonetia*, and that certain groups of fungi are wholly wanting, notably the *Hypodermei*, wanting also on the orange. (E. F. S.)

911. CHATIN, M. **Prix Thore (Commissaires: MM. Duchartre, Blanchard, Van Tieghem, Bornet; Chatin, rapporteur).** <Comp. rend. Acad. des sc., vol. CXIII, Paris, Dec. 21, 1891, p. 923.

Note on the conferring of this academic prize on MM. J. Constantin and L. Dufour for their *Nouvelle Flore des Champignons*. This flora, modeled on M. Gaston Bonnier's phænogamic flora, contains 3,842 figures, and has for its object the easy determination of all the fungi growing in France as well as of most European species. (E. F. S.)

912. COLENSO, W. **An enumeration of fungi recently discovered in New Zealand.** <Trans. & Proc. New Zealand Inst. for 1890, vol. XXIII, Wellington, May, 1891, pp. 391–398.

Gives list of species collected in New Zealand as identified by M. C. Cooke in London, Eng. (J. F. J.)

913. ELLIS, J. B., and EVERHART, B. M. **New species of fungi.** <Jour. Mycol., vol. VII, No. 2, Washington, Mar. 10, 1892, pp. 130–135.

The following new species are described: *Puccinia suksdorfii* on leaves of *Troximon glaucum*; *P. agropyri* on leaves of *Agropyrum glaucum*; *Stictis compressa* on dead limbs of *Carpinus americana*; *Tryblidiella pygmæa*, on weather-beaten wood; *Valsaria hypoxyloides* on shrub or tree from Paraguay; *Phyllosticta gelsemii* on leaves of *Gelsemium sempervirens* (cult.); *P. rhododendri* on leaves of *Rhododendron catawbiense*; *Sphæropsis albescens* on dead limbs of *Negundo aceroides*; *Stagonospora spinaciæ* on spinach; *Septoria elymi* on leaves of *Elymus canadensis*; *S. jackmani*, on leaves of *Clematis jackmani*; *S. saccharina* on leaves of seedling *Acer saccharinum*; *S. drummondii*, on leaves of *Phlox drummondii*; *Hendersonia geographica*, on fal. n and decaying chestnut leaves; *Glœosporium catalpæ* on leaves of *Catalpa bignonioides*; *G. decolorans* on leaves of *Acer rubrum*; *Melanconium magnoliæ* on dead trunks of *Magnolia glauca*; *Pestalozzia lateripes* on dead legumes of *Cassia chamæcrista*; *Scolecotrichum caricæ* on leaves of *Carica papaya*; *Macrosporium tabacinum* on leaves of cultivated tobacco; *M. longipes* on the same; *Brachysporium canadense* parasitic on *Valsa ambiens*?; and *Clasterosporium populi* on leaves of *Populus tremuloides*, and *P. grandidentata*. (J. F. J.)

914. ELLIS, J. B., & HALSTED, B. D. **New fungi.** <Jour. Mycol., vol. VI, Washington, May, 1890, pp. 33-35.

Describe the following new species: *Phyllosticta molluginis* on *Mollugo verticillata; Septoria rudbeckiæ* on *Rudbeckia laciniata* and *R. hirta; Glœosporium cladosporioides* on *Hypericum mutilum; Cylindrosporium iridis* on *Iris versicolor; Zygodesmus pyrolæ* on *Pyrola rotundifolia; Cercospora lysimachiæ* on *Lysimachia stricta: C. cleomis* on *Cleome pungens;* and *Colletotrichum spinaciæ* on spinach. (J. F. J.)

915. ELLIS, J. B., & GALLOWAY, B. T. **New species of fungi.** <Jour. Mycol., vol. VI, Washington, May 14, 1890, pp. 31-33.

Describe the following new species: *Æcidium crepidicolum* on *Crepis acuminata; Ustilago (Sorosporium?) brunkii* on *Andropogon argenteus; Sorosporium ellisii* Winter, var. *provincialis* on *Andropogon provincialis; S. everhartii* on *Andropogon virginicus; Didymosphæria denudata* on dead oak limbs; *Ophionectria everhartii* on old *Diatrype stigma* and decaying bark of oak limbs; *Glœosporium paludosum* on *Peltandra virginica; Cercospora brunkii* on cultivated Geranium; *Dendrodochium subeffusum* on lichen thallus, and *Scoriomyces andersoni* on decaying *Pinus ponderosa.* (J. F. J.)

916. ELLIS, J. B., & LANGLOIS, A. B. **New species of Louisiana fungi.** <Jour. Mycol., vol. VI, Washington, May 14, 1890, pp. 35-37.

The following species are described: *Oidium obductum* on young *Quercus; Ovularia maclurœ* on *Maclura aurantiaca; Dactylaria mucronulata* on decaying hickory wood; *Coniosporium mycophilum* parasite on *Polyporus pergamenus* and *Lentinus ursinus; Hormodendron divaricatum* on rotten wood; *Cercospora alternantheræ* on *Alternanthera achyrantha; C. thaliæ* on *Thalia dealbata; Macrosporium carotæ* on *Daucus carota; Graphium squarrosum* on *Sambucus; Sphæridium lacteum* on decaying herbaceous stems; *Phyllosticta virens* on *Quercus virens; Vermicularia discoidea* on *Panicum proliferum; Haplosporella tingens* on *Andropogon muricatus; Diplodia bambusæ* on dead *Bambusa; D. cucurbitaceæ* on dead pumpkin vines; *Botryodiplodia varians* on dead *Lagerstrœmia; Hendersonia tini* on *Viburnum tinus,* and *Prosthemiella hysterioides* on decorticated wood of *Salix nigra.* (J. F. J.)

917. ELLIS, J. B., & TRACY, S. M. **A few new fungi.** <Jour. Mycol., vol. VI, Washington, Sept. 10, 1890, pp. 76-77.

The following species are described: *Phyllachora stenostoma* on *Panicum brizanthemum; Fusarium celtidis* on *Celtis occidentalis; Cladosporium velutinum* on *Phalaris canariensis; Puccinia apocrypta* on *Asprella hystrix; Uredo peridermiospora* on *Spartina glabra; U. nyssæ* on *Nyssa capitata; Ustilago buchloës* on *Buchloë dactyloides; Cintractia avenæ* on *Avena elatior; Sorosporium granulosum* on *Stipa viridula; Ustilago hilariæ* on *Hilaria jamesii,* and *U. oxalidis* in ovaries of *Oxalis stricta.* (J. F. J.)

918. GARCIDA, MANUEL MARTENES. **Catalogos de la Flora y Fauna del Estado de Oxaca.** <Imprenta del Estado á cargo de Ignacio Candiani, Oxaca, 1891, pp. II, 116.

Gives an alphabetic list of plants on pp. 1-48, arranged by the common name, followed by the scientific name, family, and authority. Some fungi of the genera *Uredo* (*U. maidis* DC.), *Agaricus, Boletus, Hypophyllum* are given. (W. T. S.)

919. KARSTEN, P. A. **Fragmenta mycologica, XXXII..** <Hedwigia, Bd. XXX, Dresden, Sept. and Oct., 1891, pp. 246-248.

Notes on a number of old species, and descriptions of the following new species and varieties from Finland: *Mycena simillima* on decaying trunks; *Volvaria virgata,* Fr. v. *fennica* "in vaporariis;" *Cortinarius cinnamomeus* (Linn) Fr. v. *fusipes; Bjerkandera rosemaculata* on cut trunks of *Larix siberica; Ephelina aggregata* (Lasch) Karst (*Sphaeria aggregata* Lasch, in Rab. Herb. myc., II, 541) *Zignoella boreella* on disks of *Valsa borealis; Monilia obducens* on bodies of alcoholic specimens of *Colubrus natrix; Fusariella cladosporioides* on living leaves of *Myrtus; Botrytis virella,* Fr. var. *ærugineoglauca* on decaying wood. (W. T. S.)

920. KARSTEN, P. A. **Fragmenta mycologica XXXIII.** <Hedwigia, Bd. XXX, Dresden, Nov. u. Dec. 1891, pp. 298-300.

Notes on old species and descriptions of following new species and varieties from Finland: *Psathyrella longicauda,* among rotten leaves; *Poria labyrinthica,* on decaying pine wood; *Peziza lætissima,* on rotten leaves; *Melanospora macrospora,* on decaying tubers of *Brassica napus* var. *napobrassica; Botrytis laxissima,* on decaying substances on damp ground; *Hymenula vulgaris,* Fr. var. *brassicæ,* on decaying tubers of *Brassica napus* var. *napobrassica; Symphyosira alba,* on wood in fields. (W. T. S.)

921. KARSTEN, P. A. **Fragmenta mycologica XXXIV.** <Hedwigia, Bd. XXX, Dresden, Nov. u. Dec. 1891, pp. 300-303.

Gives notes on old species and descriptions of the following new species and varieties: *Pistillaria cylindracea,* on petioles of decaying leaves of *Alnus incana; P. fulvida,* on decayed leaves of *Cornus sanguinea; Discinella* n. g. [Pezizaceæ]; *D. corticalis,* on dead trunks of *Lonicera tartarica; Pestalozzia inquinans,* on living leaves of *Camellia; Fusicladium livistoniæ,* on petioles of living leaves of *Livistonia chinensis; Cylindrium flexile,* on branches of *Tilia* and *Pyrus; Hymenula microsporella,* on decaying tubers of *Brassica napus* var. *napobrassica; Myropyris guttiformis,* on the interior of decaying bark; *Hormiactis nectriæ,* on *Nectria coccineum; Sporotrichum vile,* on *Cladosporium* on stems of *Brassica napus.* (W. T. S.)

922. LAGERHEIM, G. **Observations on new species of fungi from North and South America.** <Jour. Mycol., vol. VII, Washington, Sept. 10, 1891, pp. 44-50.

Describes a hollyhock disease caused by a new species of fungus, *Puccinia heterogenea;* a new cotton rust caused by *Uredo gossypii;* a new *Doassansia* on cotton, called *D. gossypii;* and a new *Peronospora* on *Gonolobus* from South Carolina, called *P. gonolobi.* The first three species are from Ecuador. (J. F. J.)

923. Ludwig, F. **Contributions on the fungal flora of Australia.** <Trans. Roy. Soc. South Australia, vol. xiv, Adelaide, July, 1891, pp. 55–60.

Part I deals with the rusts and smuts (*Uredineæ* and *Ustilagineæ*) giving a list of 45 species. Part II gives a list of the fungous enemies of Eucalyptus and Acacia, 22 in all. Of these, the following are named as new species, the authority given being Saccardo, except for the last. No descriptions are given. *Ceriomyces incomptus*, *Rhamphoria tenella*, *Phyllosticta phyllodiorum*, *Septoria phyllodiorum*, and *Uredo notabilis* Ludw. Part III is on the position of *Clathrus (Ileodictyon) tepperianus* Ludw., noting that it should probably be united with *C. gracilis* and *C. cibarius* under the latter name. (J. F. J.)

924. Plowright, C. B., Ward, H. G., and Robertson, J. **List of fungi found at Sterling on 26th and 27th October, 1891.** <Ann. Scot. Nat. Hist., vol. i, Edinburgh, Jan., 1892, pp. 68–69.

A list of species without notes. (J. F. J.)

925. Raciborski, M. **Ueber einige Pilze aus Südrussland.** <Hedwigia, Bd. xxx, Sept. u. Oct. 1891, Dresden, pp. 243–246.

Gives a list of 27 species (1 *Cystopus*, 2 *Ustilago*, 6 *Uromyces*, 7 *Puccinia*, 3 *Gymnosporangium*, 1 *Phragmidium*, 2 *Melampsora*, 3 *Æcidium*, 1 *Rhytisma*, 1 *Pleospora*), with localities and host plants. Gives notes on *Uromyces lævis* Kœrnicke, making Sydow Ured. No. 161 on *Euphorbia gerardiana*, *U. lævis* var. *trachysora* and Rabenhorst Herb. Myc. No. 299 (pro parte); on *Euphorbia verrucosa* he makes *U. scutellatus* Schrank var. *leptoderma*. Thinks Magnus and Dietel may be mistaken in referring *U. lævis* to *Uredo excavata* DC., which the author thinks more probably identical with *Melampsora euphorbiæ dulcis* Otth. (W. T. S.)

926. Richon, Ch. **Liste alphabétique des principaux genres mycologiques dont les spores, sporidees et conidies sont représentées fortement amplifiées, avec l'indication de leurs dimensions réelles.** <Rev. Mycol., vol. xiii, Toulouse, Oct., 1891, pp. 160–162, pl. cxx–cxxiv.

An alphabetical list of typical species selected to illustrate 287 genera beginning with *Leptosphærites lemoinii*. Each species enumerated is illustrated. (E. A. S.)

927. Rolland, L. **Quelques champignons nouveaux du Golfe Juan.** <Bull. Soc. Mycol. France, vol. vii, fasc. 4, Paris, Dec. 31, 1891, pp. 211–213, pl. xiv.

Describes the following: *Calosphæria punicæ*, *Amphisphæria cocos*, *Gibberella trichostomi*, *Mollisia ericæ*, *Glæosporium suberis*, *Stictis opuntiæ*. (E. A. S.)

928. Roumeguère, C. **Fungi exsiccati precipue Gallici, LX^{e} centurie.** <Rev. Mycol., vol. xiv, Toulouse, Jan. 1, 1892, pp. 1–11.

List of 100 fungi and their hosts, containing the following new species: *Phacidium jacobææ* Faut. and Roum., on *Senecio jacobæa*; *Calloria medicaginis* Faut. and Roum., on *Medicago sativa* form *meliloti* on *Melilotus officinalis*; *Saprolegnia quisquiliarum*; *Didymosphæria ammophilæ* Faut. and Roum., on *Ammophila arenaria*; *Læstadia mespili*, on *Mespilus germanica*; *Venturia furcata* on *Sabina*; *Leptosphæria viticola* Faut. and Roum., on *Vitis vinifera*; *L. phaseoli* Faut. and Roum., on *Phaseolus nanus*; *L. melanommiodes*, on *Phaseolus nanus*; *L. sambuci*, on *Sambucus nigra*; *Hendersonia peregrina*, on *Phœnix dactylifera*; *H. calospora*, form *unioeæ*, on *Uniola latifolia*, form *pœsudeticæ*, on *Poa sudetica*, form *ammophilæ* on *Ammophila arundinacea*; *H. culmifraga*, on *Uniola latifolia*; *Dendrophoma didyma* Faut and Roum., on *Quercus pedunculatus*; *Rhabdospora campanulæ*, on *Campanula trachelium*; *Ramularia picridis* Faut and Roum., on *Picris hieracioides*; *R. beccabunga*, on *Veronica beccabunga*; *Balacotricha lignorum* Faut and Roum., on rotten oak plank. (E. A. S.)

929. Roumeguère, C. **Fungi Gallici exsiccati.** <Rev. Mycol., vol. xiii, Toulouse, Oct., 1891, pp. 163–173.

A list of 100 fungi, containing also names of hosts, synonyms and localities. Several new species are described: *Thyridium betulæ*, on *Betula alba*; *Sphærella acerna*, on *Acer campestre*; *S. nigrificata* Faut. & Roum., on *Agrostis stolonifera*; *S. juniperi* Faut. and Roum., on *Juniperus communis*; *S. maculata*, on *Prunus mahaleb*; *Leptosphæria rumicis*, on *Rumex patientia*: *Lophodermium sabinæ*, on *Juniperus sabina*; *Coniothyrium phalaridis* Faut. and Roum., on *Phalaris arundinacea*; *Phoma solani-lycopersici* Faut. and Roum., on *Solanum lycopersicum*; *P. populi-tremulæ*, on *Populus tremula*; *Cytospora viburni* Faut. and Roum., on *Viburnum lantana*; *Rhabdospora aconiti*, on *Aconitum napellus*; *Diplodia sambucicola*, on *Sambucus nigra*; *Pestalozzia sabinæ* on *Juniperus sabina*; *Myxosporium sabinæ* Faut. and Roum., on *Juniperus sabina*; *Coryneum avellanæ* on *Corylus avellana*; *Trinacrium variabile* on *Solanum lycopersicum*; *Dendrodochium lignorum*, on oak bark; *Fusarium discoideum* Faut. and Roum., on *Sambucus nigra*. (E. A. S.)

930. Saccardo, P. A. **Rathschläge für die Phytographen, insbesondere die Kryptogamisten.** <Hedwigia, Bd. xxx, Dresden, Jan. u. Feb. 1891, pp. 56–59.

Recommends the following rules to phytographers: (1) Give concise diagnoses of a new species, not extended accounts of its morphology and biology without any clear statement of its distinguishing characters; (2) Diagnoses should be in clear and concise form, giving the important and distinctive characters; remarks on details should be given after the diagnosis, and it is necessary to indicate the relationships of the species; (3) The name of the original author of a species that has been removed to another genus should be given in parenthesis as the author of the species, and outside the parenthesis should be placed the name of the person who transferred the species to another genus; (4) The scientific name of the host organism should always be given in describing parasitic species; (5) The metric system should be used in giving the size of organs; for microscopic measurements, micromillimeters or mikra (μ) are to be employed instead of fractions; (6) For expressing concisely the dimensions of microscopic organs the length should first be given, then the width, the numbers being connected by the sign $\asymp$ and the sign μ omitted. The sign $\asymp$ (which the author proposed in 1872) has the advantage over the signs =, : , × of not having a different and definite

meaning in mathematics; (7) All names of all groups of plants should be in the feminine gender -*Hymenomyceteæ*, not Hymenomycetes; (8) A distinct nomenclature based upon normal examples of colors should be followed; (9) It would be useful in case of fungi to use only the following names for fruits and spores, since these names are already in use by most mycologists; *Hymenomyceteæ*, pileus, basidia, sterigmata, sporæ, cystidia; *Gasteromyceteæ*. and *Myxomyceteæ*, peridium, gleba, capillitium, flocci, sporæ; *Uredineæ*, sorus, uredosporæ, teleutosporæ, mesosporæ, pseudoperidium, æcidiosporæ, paraphyses; *Phycomyceteæ*, oögonia, oösporæ, antheridia, spermatia, zygosporæ, azygosporæ, zoösporangia, zoösporæ; *Pyrenomycetaceæ* and *Phymatosphæriaceæ*, stroma, perithecium, loculus, ascus, sporidia, paraphyses; *Discomyceteæ*, and *Tuberoideæ* ascoma, gleba, ascus, sporidia, paraphyses; *Schizomyceteæ*, filamenta, baculi, cocci, endosporæ, anthrosporæ; *Sphæropsidæ*, [sic] perithecium, basidia, conidia (but not *gonidia*, a term to be restricted to lichens); *Hyphomyceteæ*, cæspitulus, sporodochium, hyphæ, sporæ. The promycelium originating from the germinating spore generally bears sporidiola. (W. T. S.) (See No. 565; also Bot. Gaz., vol. XVI, May, 1891, pp. 153–155.)

931. SPEGAZZINI, CAROLO. **Fungi guaranitici nonnulli novi v. critici.** <Revista Argentina Hist. Nat., vol. 1, Buenos Aires, Dec. 1, 1891, pp. 398–432.

Gives notes on many species and descriptions of the following new ones: *Æcidium convolvulinum* on *Convolvulaceæ*; *Æ. talini* on *Talinum patentis*; *Æ. xanthoxylinum* on *Xanthoxylum*; *Æ. calyculatum* on *Hamelia* sp.; *Æ. ochraceum* on *Tabernæmontanum*; *Æ. asclepiadinum* on *Morreniæ*; *Tuberculina talini* on *Talinum patentis*; *Meliola obesula* on *Rutaceæ*; *M. lævipoda* on *Aspidosperma quebrachii*; *M. harioti* on *Bignoniaceæ*(?) and *Leguminosæ*(?); *M. sapindacearum* on *Sapindaceæ*; *Dimerosporium? ovoideum* on *Gramineæ*; *D. superbum* on *Croton* sp.; *Broomella phyllocharis*; *Phyllachora læviuscula* on *Rubiaceæ*; *P. quebrachii* on *Aspidosperma quebrachii*; *P. subtropica*; *P. gentilis* on *Eugenia*; *P. acutispora* on *Gramineæ*; *Microthyrium acervatum* on *Rutaceæ*; *Seynesia? nebulosa* on *Myrsine*; *Asterina sphærebloides*; *Trichothyrium fimbriatum*; *Micropeltis vagabunda* on *Aspidosperma quebrachii*; *M.(?) balansæ*; *Lembosia nobilis*; *Peziza edulis* on earth; *Phyllosticta eryngii* on *Eryngium pandanifolium*; *Chætophoma chlorospora* on *Randia*; *Rabenhorstia discoidea* on decaying *Carica*; *Pseudopatella* (n. gen.); *P. lecanidion* on *Citrus aurantiacus*; *Septoria eugenicola* on *Eugenia*; *S. eugeniarum* on *Eugenia*; *Leptothyrium magnum* on *Nectandra*; *L. ampullulipedum* on *Lauraceæ*; *Asterostomella cristata* on *Rutaceæ*; *A. subreticulata* on *Cestrus pubescens*; *A. cingulata* on *Euphorbiaceæ*; *Melasmia pulchella* on *Eugenia*; *Melophia macrospora* on *Eugenia*; *M. superba* on *Myrtus guavigus*; *Glœosporium tabernæmontanæ* on *Tabernæmontanum*; *Melanconium? bambusinum* on *Bambusaceæ*; *Cylindrosporium olyria* on *Olyria*; *Oospora versicolor*; *Heterosporium chloridis* on *Chloris*; *Sarcinella? solanicola* on *Solanaceæ*; and *Atractium? cronartioides* on *Bignoniaceæ*. (J. F. J.)

932. TOLF, ROBERT. **Mykologiska notiser från Småland I. Uredineer, Peronosporéer, Perisporiacéer.** <Botan. Notiser, Lund, 1891, pp. 211–220.

The author gives a list of fungi collected in Småland (Sweden). About 100 species of *Uredineæ*, 30 *Peronosporaceæ*, and 19 species of *Perisporiaceæ* are enumerated. No new species are recorded. (Theo. Holm.)

II.—CHYTRIDIACEÆ.

933. DANGEARD, P. A. **Mémoire sur quelques maladies des algues et des animaux, phénomenès de parasitisme.** <Le Botaniste, 2e sér., Paris, 12 Août 1891, pp. 232–264, pl. 4.

The author divides the memoir into three chapters, the first relating to parasites found upon marine algæ growing in the maritime laboratory of *Luc-sur-Mer*, the second to diseases found in the cultures of fresh-water algæ, and the third to a few diseases of lower animals. In Chapter I are described, with figures, *Ciliophrys marina* n. s. (saprophytic) and *Aphelidium lacerans* De Bruyne (parasitic) on *Ulva lactuca*, and *Olpidium aggregatum* n. s. on *Cladophora marin*, notable as being a member of the family *Chytridiaceæ* on a marine alga. Chapter II treats of the monadine, *Endomonadina concentrica* nov. gen., nov. sp., producing an epidemic disease of *Palmella hyalina* (?); of *Minutularia elliptica*, n. s. on alga undetermined, which, together with the *Chytridium destruens* Nowak, placed by Dangeard in *Minutularia*. form a small genus by themselves on *Draparnaldia glomerata*, causing a true epidemic *Chytridium mamillatum* Braun. on *Conferva bombycina*; *Chytridium assymetricum*, n. sp. on *Zygnema*; *C. sphærocarpum* (*Rhizidium*, Zoph) on *Zygogonium*; *Micromyces zygogonii*, Dangeard, on divers algæ, Oscillarias and Nitellas; *Gymnophrydium hyalinum*, n. g., n. sp. on *Euglena*; *Nuclearia minima*, n. sp. *N. delicatula* Cienk, and *Piatoum* (*Clamydophrys*) *stercoreum*, Cienk, on *Closterium*; *Antlea Closterii*, n. g., n. s., *Nuclearia simplex* Cienk. and *Bacillus closterii*, n. sp.. are also described. Chapter III describes the following diseases; *Harposporium anguillulæ* Lohde. on Anguillæ, and a bacterial disease of *Ophrydium versatile*, which suggests to the author that the struggle between the nucleus of the cell attacked and the bacteria is prolonged by the former's peculiar long ribbon shape. Throws out suggestion that the nuclei of the cells of fungi and higher plants, as well as of animal cells, are principally storehouses of food for the surrounding protoplasm, and the protoplasm dies only when the stock of nutriment in the nucleus is exhausted. (D. G. F.)

(See also, Nos. 736 and 832.)

III.—OOMYCETES.

934. SWINGLE, W. T. **Some Peronosporaceæ in the herbarium of the Division of Vegetable Pathology.** <Jour. Mycol., vol. VII, No. 2, Washington, Mar. 10, 1892, pp. 109–130.

Gives notes, with mention of localities, on 46 species of *Peronosporaceæ*. *Albugo* Persoon=*Cystopus* Lév. Tables of measurements are given of conidia of *Plasmopara gonolobi*, and of oöspores of *Peronospora cynoglossi*, and *P. echinospermi*. *P. echinospermi* Swingle=*P. cynoglossi* var. (?) *echinospermi*. (J. F. J.)

935. WAITE, M. B. **Description of two new species of Peronospora.** <Jour. Mycol., vol. VII, No. 2, Washington, Mar. 10, 1892, pp. 105–109, pl. XVII.

Describes two new species under names of *Peronospora celtidis* on *Celtis occidentalis*, and *P. hydrophylli* on *Hydrophyllum virginicum*. (J. F. J.)

(See also, Nos. 695, 716, 724, and 889.

IV.—ZYGOMYCETES.

936. MAYER, W. **Die Hefereinzucht und ihre Bedeutung für die Gährungs-Industrie.** <Der Technicker. Internat. Fachbl. teckn. Wissensch., Jahr. XIV, No. 4, New York, Feb., 1892, pl. 1, figs. 3.

A review of recent progress in the matter of using pure yeast. Mentions and figures *Mucor mucedo*. Nothing original is given on fungi. (W. T. S.)

(See also, No. 736.)

V.—BASIDIOMYCETES.

937. A., * * * T. E. **Gigantic puffball.** <Science Gossip, No. 324, London, Dec., 1891, p. 281, $\frac{1}{6}$ col.

Notes a specimen of *Lycoperdon boviata* [sic] found in Suffolk, 4 feet in circumference. (J. F. J.)

938. [Anon.] **An edible fungus of New Zealand.** <New Zea. Journ. Sci., new ser., vol. I, Dunedin, Mar., 1891, pp. 55–58.

Refers to *Hirneola polytricha* Mont. and quotes from Colenso in Trans. of Penzance Nat. Hist. and Antiq. Soc., 1884–'85, a description of same. In 12 years 1,850 tons 11 cwt., valued at £79,752, were exported. Notes analysis made by A. H. Church. (J. F. J.)

939. [Anon.] **Exportation de Champignons néo-zélandais en Chine.** <Rev. Sci. Nat. Appli., vol. XXXVIII, Paris, Aug. 5, 1891, pp. 237–238.

Note from a Kew Bulletin on the chemical composition and commercial importance of *Hirneola polytricha*. (E. F. S.)

940. BING, F. G. **Curious growth of fungi.** <Science Gossip, No. 325, London, Jan., 1892, p. 22, $\frac{2}{3}$ col.

Describes a specimen of *Agaricus* sp. (?) in which three individuals were united. Notes also that where turf had been removed the place was marked by a ring of toadstools. (J. F. J.)

941. ELLIS, J. B., and EVERHART, B. M. **Mucronoporus andersonii, n. sp.** <Jour. Mycol., vol. VI, Washington, Sept. 10, 1890, p. 79.

Description of species as given in title. (J. F. J.)

942. FISCHER, ED. **Beiträge zur Kenntniss exotischer Pilze. II. Pachyma cocos und ähnliche sklerotienartige Bildung.** <Hedwigia. Bd. XXX, Dresden, März u. April, 1891, pp. 61–103, pl. VI–XIII.

The paper deals with various tuberiform fungous bodies, most of which have long been known. On pages 62–79 is given a full description of *Pachyma cocos*, Indian bread, or tuckahoe, prefaced by a summary of our previous knowledge on the subject. The author describes the anatomy of the tuberiform bodies, recognizing three component parts, hyphæ, smooth, refractive bodies, and striated lumps, also highly refractive. All of these are considered to be of fungous nature and the author shows that the hyphæ are changed into the refractive bodies, and that often the two can be seen still in actual connection and the intermediate stages of the change traced. Intermediate stages can also be observed between the refractive bodies and the striated lumps. Then the author gives a description of the connection of the *Pachyma* with the roots of trees in two specimens at his disposal. In both cases the wood was of a dicotyledonous plant, and not of a conifer, which is opposed to a prevailing idea as to their mode of occurrence. The hyphæ were found to enter the wood cells, swell up to refractive bodies and finally to dissolve the wood. On pages 79–97 the sclerotium of *Polyporus sacer* Fr. is fully described and illustrated with plates. The sclerotium is composed of delicate hyphæ, rounded or oval refractive bodies, much like starch grains in appearance, and smaller swollen thick-walled cells rich in protoplasmic contents. The oval bodies show concentric stratification when treated with KHO or other solvents. They are not connected with the hyphæ, though very rarely one could be seen that bore a filamentous prolongation. The author concludes, however, that the oval bodies arise from the hyphæ, as do the irregular refractive bodies of *Pachyma*. Considers *Polyporus scleropodius* Lév. as very probably the same as *Polyporus sacer* Fr. On pages 97–102 short accounts are given of *Tuber-regium* producing *Lentinus tuber-regium* Fr. and a number of other *Lentinus*-producing sclerotia; of *Mylittia lapidescens* Horan. producing *Agaricus* (*Omphalia*) *lapidescens* (Horaninow) F. Conn. and J. Schroeter; of *Sclerotium stipitatum* Berkeley, which the author considers as being a fructification of a fungus and not a sclerotium; and finally a notice of *Pietra fungaja* of south Italy, which produces *Polyporus tuberaster* Jacq. (W. T. S.)

943. Fischer, Ed. **Nachtrag zur Abhandlung über Pachyma cocos.** <Hedwigia, Bd. xxx, Dresden, Juli u. August, 1891, pp. 193–194.

Supplementary to No. 942; adds a notice of a paper by J. Schrenk and one by H. N. Ridley which had not been seen by the author when the original paper was written. Corrects a reference to the views of Murray as to the identity of *Lentinus scleroticola* Murray and *L. cyathus* B. & Br. (W. T. S.)

944. Fischer, Ed. **Notice sur le genre Pachyma.** <Rev. Mycol., vol. xiii, Toulouse, Oct., 1891, pp. 157–160.

Shows that the coralloid refringent bodies are of fungous origin and in direct connection with the hyphæ of the sclerotium. Describes their formation, and the relation of the fungous to the wood of the host. Judging from the resemblance of *P. cocos* to *P. malacense*, the author is inclined to the belief that the former is also a sclerotium form of a Hymenomycete. In the case of *P. malacense* he shows that the *Polyporus* growing from it is produced from the hyphæ of the sclerotium. (E. A. S.)

945. Griset, Henry E. **Large fungi.** <Science Gossip, No. 322, London, Oct., 1891, p. 239, ⅙ col.

Gives dimensions of specimens of *Lycoperdon giganteum* and *Phallus impudicus*. One of the former was 11 inches "long;" another was 22½ inches in circumference. The *Phallus* was 9¾ inches high with a stipe 1¼ inches in diameter. (J. F. J.)

946. Griset, Henry E. **Observations on Phallus impudicus.** <Science Gossip, No. 325, London, Jan., 1892, pp. 16–17, fig. 3.

Describes appearance and growth of the fungus with mention of measurements of a large specimen, 13 inches high, pileus 3½ inches long, column 2 inches in diameter, volva 4 inches long and ½ half inch thick. (J. F. J.)

947. Hariot, P. **Sur quelques champignons de la Flore d'Oware et de Bénin de Palisot Beauvois.** <Bull. Soc. Mycol., France, vol. vii, fasc. 4, Paris, Dec. 31, 1892, pp. 203–207.

Gives a historical discussion of the genus *Favolus*, notes on the synonomy of *Dædalea amanitoides* (Pal.) Beauv., and notes and description of the genus *Microporus* Pal. To these are added the descriptions of two new species of *Hexagona*, *H. deschampsii*, and *H. elegans*. (E. A. S.)

948. K. ———. **Review of "Illustrations of British fungi," by M. C. Cooke.** <New Zea. Journ. Sci., new ser., vol. i, Dunedin, Nov., 1891, pp. 264–265.

Brief notice of the book, with mention of fact that only 30 species of Agaricini have been so far described from New Zealand. (J. F. J.)

949. Kirtikar, K. R. **Notes on a rare fungus growing on the drumstick tree.** <Jour. Bombay Nat. Hist. Soc., vol. vi, Bombay, 1891, pp. 219–222, pl. A.

Describes species growing on *Moringa pterygosperma*, for which, if new, the name *Agaricus (Pleurotus) moringanus* is proposed. (J. F. J.)

950. Massee, George. **Mycological Notes. II.** <Jour. Mycol., vol. vi, Washington, April 30, 1891, pp. 178–184, pl. 1 (vii).

Gives notes on many species, with changes in nomenclature, and describes the following as new: *Sarcomyces* n. gen., *Dacryopsis* n. gen. (J. F. J.) (See No. 636.)

951. Meschinelli, L. **Di un probabile agaricino miocenico.** <Atti d. Soc. Veneto-Trentina di Sc. Nat., vol. xii, Padova, 1891 (1892), pp. 310–312, pl. 1.

Describes a fossil species of Agaricus in honor of Lester F. Ward, *Agaricus wardianus*, collected at Chiavon, in the Province of Vicenza, situated in the ash-colored marls belonging to the Aquitanian, corresponding in part to the base of the strata of Sotzka, and belonging like it to the base of the lower Miocene. The author figures peculiar perpendicular and horizontal striations upon the fossil which have no analogues in living species and make the determination doubtful. Microscopic examination revealed no spores or hyphæ. (D. G. F.)

952. Moxon, R. **Huge puffballs.** <Science Gossip, No. 323, London, Nov., 1891, pp. 261–262, ⅙ col.

Records a specimen of *Lycoperdon giganteum*, found in Surrey, 36 inches in circumference and 34 inches round the top. (J. F. J.)

953. Patouillard, N. **Podaxon squamosus, nov. sp.** <Bull. Soc. Mycol., France, vol. vii, Paris, Dec. 31, 1891, p. 210, pl. 1 (xiii).

Gives a technical description of the fungus and an uncolored plate, natural size. (E. A. S.)

954. Prillieux & Delacroix. **Hypochnus solani, nov. sp.** <Bull. Soc. Mycol., France, vol. vii, Paris, Dec. 31, 1891, pp. 220–221, fig. 1.

Gives popular and technical description of the fungus. (E. A. S.)

955. TANAKA, NOBUJIRO. **A new species of Hymenomycetous fungus injurious to the mulberry tree.** <Jour. Coll. of Sci. Imp. Univ. Japan, vol. IV, Tokyo, 1891, pp. 193–204, pl. 4.

Describes the morphology and discusses the systematic position of a fungus producing the disease known as "Mompa-byo." Fungus first attacks roots and spreads to parts above ground. Name proposed for it is *Helicobasidium mompa*. (J. F. J.)

956. VOGLINO, P. **Nota micologica.** <Nuovo Gior. Bot. Ital. (Bull. d. Soc.), vol. XXIII, Firenze, April 6, 1891, pp. 550[350]–353.

Gives list with notes of fungi, mostly Hymenomycetes collected near Casale, citing a few not previously recorded for Italy. (D. G. F.)

(See also, Nos. 882 and 923.)

VI.—UREDINEÆ.

957. ANDERSON, F. W. **Notes on certain Uredineæ and Ustilagineæ.** <Jour. Mycol., vol. VI, Washington, Jan. 6, 1891, pp. 121–127.

Refers to species of Æcidium, Puccinia, etc., giving notes on synonomy. Describes as new *Æcidium palmeri* on *Pentstemon virgatus*, *Puccinia windsoriæ* var. *australis*, and *P. kamtschatkæ*, the last from the collection of the U. S. Explor. Expedition. Gives also notes on other species collected by the expedition. (J. F. J.)

958. BARCLAY, A. **On two autœcious Cæomata in Simla.** <Scien. Mem. by medical officers Army of India, part VI, Calcutta, 1891, pp. 65–69, pl. 1; also reprinted.

Describes a new variety *himalayensis*, of *Puccinia prenanthes* Pers. occurring on leaves of *Prenanthes brunoniana* Willd., and *Lactuca macrorhiza* Hook. f. All three stages were found and the author thinks the fungus is autœcious, though he did not succeed in definitely proving it. Figures of the species are given. Then he describes a new species, *Puccinia prainiana*. Author has found all stages of this fungus on *Smilax aspera* and succeeded in producing the spermogonia by infection with teleutospores. Gives figures of the species. General remarks are appended on the *Cæomata* calling attention to the fact that they have been supposed to be connected with species of *Melampsora*. The author contends that this view is incorrect, as some *Melampsoræ* do not have *Cæomata* as æcidial stages and, moreover, the two *Pucciniæ* mentioned in the present paper have true *Cæomata* as æcidia. Thinks no longer a reason for maintaining the genus *Cæoma*. (W. T. S.)

959. BARCLAY, A. **Rhododendron Uredineæ.** <Scien. Mem. by medical officers Army of India, part VI, Calcutta, 1891, pp. 71–74, pl. 2; also reprinted.

Records finding of *Chrysomyxa himalense* Barclay on *Rhododendron hodgsoni* Hook. f. at Lingtu in Sikkin at 11,500–12,000 ft. The species was originally found on *R. arboreum*. Describes a new *Uredo* on *Rhododendron lepidotum* Wall., no specific name being given to the species. Also describes *Æcidium rhododendri* on *R. campanulatum* Don. Gives an interesting discussion of the relations between these forms and the *Uredineæ* on *Picea morinda* in India and *P. excelsa* in Europe. (W. T. S.)

960. CUBONI, G. **Sulla presenza di bacteri negli acervuli della Puccinia hieracii (Schumacher).** <Nuovo Gior. Bot. Ital. (Bull. d. Soc.), vol. XXIII, Firenze, 6 April, 1891, p. 296.

Records the constant presence in the pustules of *Puccinia hieracii* on *Leontodon hastilis* of numerous colonies of bacteria which give to the spots a pallid diffused surrounding ring. The presence of the organisms seems confined to the older sori. Organisms not cultivated. (D. G. F.)

961. DIETEL, P. **Beschreibung einer neuen Puccinia auf Saxifraga.** <Hedwigia, Bd. XXX, Dresden, März u. April, 1891, pp. 103–104.

Description of *Puccinia pazschkei* on leaves of *Saxifraga elatior* from near Franzenshöhe, Tirol, and on *S. aizoon* from Switzerland. The differences between this species and *P. saxifragæ* Schlecht. are pointed out. (W. T. S.)

962. DIETEL, P. **Notes on some Uredineæ of the United States.** <Jour. Mycol., vol. VII, Washington, Sept. 10, 1891, pp. 42–43.

Discusses some statements made by F. W. Anderson (see No. 957) in regard to species of the genera *Uromyces* and *Puccinia*, disagreeing in certain particulars. (J. F. J.)

963. DIETEL, P. **Ueber Puccinia conglomerata (Str.) und die auf Senecio und einigen verwandten Compositen vorkommenden Puccinien.** <Hedwigia, Bd. XXX, Dresden, Sept. u. Oct., 1891, pp. 291–297, pl. 1 (XXXVI).

Gives critical notes on all *Pucciniæ* occurring on Senecio and related Compositæ. Many different species have been placed in *Puccinia conglomerata* (Str.) by recent writers. *P. senecionis* Lib. (of which *P. subcircinata* Ell. and Ev. is a synonym) and *P. expansa* Link. should be restored to specific rank. *Puccinia glomerata* Grev., is thought to be probably nothing but the typical *P. expansa*; *P. tranzschelii* n. sp. on *Cacalia hastata* L., near Schenkursk (Prov. Archangelsk), Russia, is described, and in a supplementary note to the article it is reported from Siberia on the strength of a specimen collected by Martianow. *P. conglomerata*, *P. tranzschelii*, *P. senecionis*, *P. expansa*, and *P. uralensis* are figured in outline. (W. T. S.)

964. ELLIS, J. B, and EVERHART, B. M. **New species of Uredineæ and Ustilagineæ.** <Jour. Mycol., vol. VI, Washington, Jan. 6, 1891, pp. 118–121.

The following new species are described: *Schrœteria annulata* in ovaries of *Andropogon annulatus; Schizonella subtrifida* on *Circium ochrocentrum; Ustilago diplospora* in ovaries of *Panicum sanguinale; U. montaniensis* on *Muhlenbergia glomerata; Æcidium micropunctum* on *Castilleia; Æ. eurotiæ* on *Eurotia lanata; Uromyces scaber* on grass; *Puccinia arabicola* on *Arabis* sp.; *P. araliæ* on *Panax trifolium; P. xanthiifolia=P. compositarum* Schlect., on *Iva xanthiifolia*, and *P. consimilis* on *Sisymbrium linifolium.* (J. F. J.)

965. ERIKSSON, J. **Noch einmal Æcidium Astragali, Eriks.** <Bot. Notizer, Lund, 1891, pp. 40–43.

Finds it necessary to change name of *Æcidium astragali* Eriks., on *Astragalus alpinus*, published by the author in fac. VI, No. 285 of his Fung. par. scand. on account of De Thümen's species of same name in M. Univ., No. 1117, on *Astr. melilotoides.* Selects *Æcidium astragali-alpini* as new name and gives following synonomy: *Æ. astragali*, Eriks., Fung. par. sc., VI, No. 285. *Æ. carneum*, Nees., Bot. Notizer, 1884, p. 155. *Uromyces lapponicus*, Lagerh. (Æcidium form), Bot. Notizer, 1890, p. 274. Does not consider his species as æcidial form of Lagerheim's *Uromyces.* (Theo. Holm.)

966. GALLOWAY, B. T. **A new pine leaf rust.** <Jour. Mycol., vol. VII, Washington, Sept. 10, 1891, p. 44.

Describes a new species under name of *Coleosporium pini.* (J. F. J.)

967. ELLIS, J. B., and TRACY, S. M. **New species of Uredineæ.** <Jour. Mycol., vol. VII, Washington, Sept. 10, 1891, p. 43.

Describe the following new species: *Puccinia hemizoniæ* on *Hemizonia truncata; Æcidium oldenlandianum* on *Houstonia cœrulea;* and *Æ. malvastri* on *Malvastrum munroanum.* (J. F. J.)

968. HARIOT, P. **Notes critiques sur quelques Uredinees de l'Herbier de Muséum de Paris.** <Bull. Soc. Mycol., France, vol. VII, Paris, Sept. 30, 1891, pp. 141–149.

Notes on type specimens in cryptogamic herbarium of the Paris Museum and of the Faculty of Science at Marseilles, together with a description of several new species from different places. The following new species are described: *Uromyces cachrydis* on stems and petioles of *Cachrys; Melampsora passifloræ* on *Passiflora lutea; Puccinia longicornis* Pat. & Har. on leaves of *Bambusa; Uredo cornui* on leaves of *Euphorbia; Æcidium dichondræ* on leaves of *Dichondra; Æ. vieillardi* on leaves of *Rubiaceæ.* The following changes in nomenclature are suggested: *Uromyces acutatus* Fckl. is restricted to the host *Gagea arvensis* and is a synonym of *U. ornithogali* (Schlect.) Lév. *Puccinia porri* (Sow.) Wint. should include *Uredo ambigua* DC., *Uromyces ambiguus* (DC.) Fckl. and *Puccinia mixta* Fckl. *Melampsora pistaciæ* Cast., does not belong to the *Uredineæ. Melampsora petrucciana* Cast. is not on *Glechoma* and equals *M. helioscopiæ* Pers. *Cronartium gramineum* Mont. is a gall. *Puccinia galii* (Pers.) Schw. should include as synonyms *P. crucianellæ* Desmaz., *Uredo galii-veri* Cast., and *Æcidium galii* Pers. *P. hieracii* (Schum.) Mart. includes *P. hieracii-murorum* Cast. and *P. centaurea-aspera* Cast. on *Centaurea aspera. P. centaurea-aspera* Cast. on *Picnomon acarna* belongs to *P. tanacei. Puccinia bullata* (Pers.) Schroet. includes *P. apii-graveolentis* Cast., *P. apii* Cda., *P. apii* Desmaz., and *P. castagnei* Thüm. *P. Berkleyi* Pass. is a synonym of *P. vincæ* Cast. *P. alii* Cast. on *Allium ampelopnasum=P. allii* (DC.) Rud. *P. kraussiana* Cke. can not be maintained and is merged into *P. ferruginea* Lév. *P. arenariæ* (Schum.) Schroet. has as synonyms *P. montagnei* de Toni, *P. herniariæ* Ung., and *P. corrigiola* Chev. The synonymy of *P. cnicioleracei* Desm is as follows: *P. asteris* Duby, *P. cirsiorum* Desmaz., *P. silphii* Schw., *P. xanthii* Schw.? *P. leveilleana* de Toni was previously described by Montagne as *P. leveillei. P. jurinæ* Rab. is only a variety of *P. pulvinata* Rab., and this should probably include *P. jurinæ* Cke. *Coleosporium baccharidis* (Lev.) Cke. includes *Uredo baccharidis* Lev., *Col. baccharidis* Cke., and the so-called Æcidium portion of *P. evadens* Wint. (No. 3208, F. Europæi). *Uredo baccharidis* Speg. is a synonym of *U. balansæ* Har. *U. avenæ* Cast. and *U. glumarum* Rob. are synonyms of *P. rubigo-vera* (DC.) Wint. *Uredo beticola* Bell.=*Uromyces betæ* (Pers.) Kühn. *Uredo camphorosmæ* Cast.=Uredo spores of *Uromyces salicorniæ* (DC.) DBy. *Uredo cucubali* Desmaz. and *U. lychnidearum* Desm. are the Uredo form of *P. silenes* Schrœt. *Uredo holoschœni* Cast. is on *Juncus* and equals *Uromyces junci* (Desm.) Tul. *Uredo ilicis* Cast.=*U. quercus* de Brond. It is perhaps a *Melampsora. Uredo kleiniæ* Mont.=*Coleosporium senecionis* (Pers.) Fr. *Uredo phyllariæ* Cast. on *Phyllirea angustifolia=Cœoma phyllyræ* (Cke.) Thum. and Bagn., but Castagne's name is the older. *Uredo poæ-sudeticæ* West. is the Uredo of *P. poarum* Niels. *P. pruni* Pers. includes *Uredo pruni* Cast., *Uromyces amygdali* Passer., and *Uredo castagnei* Mont. *Uredo scirpi* Cast. belongs to *Uromyces lineolatus* (Desm.) Schrœt. The same species is also in Castagne's herbarium under the name *Uredo prismaticus. Uredo tropæoli* Desm.=*Cœoma tropæoli* (Desm.) *Uredo anagyridis* Roussel=*Uromyces anagyridis* (Roussel) Roumeg. *Uredo andropogoni* Cast. corresponds exactly to *P. cesatii* Schrœt. *Uredo dianthi* Cast. is a synonym of *Uromyces caryophyllinus* (Schrank) Schrœt. *Uredo erigeronis* Requien upon *Cupularia viscosa* and *Æcidium sonchi* West, belongs to *Coleosporium sonchi* (Pers.) Lév. *Uredo lolii* Cast. belongs to *P. graminis* Pers. *Uredo polygonorum* v. *aviculare* Cast.=*Uromyces polygoni* (Pers.) Fckl. *Uredo satureiæ* Cast.=*P. menthæ. Uredo tumida* Gachet on *Populus balsamifera=Melampsora populina* (Jacq.) Lév. *Uredo berberidis* Lév. and probably *Uredo æcidiiformis* Speg. are synonyms of *Cœoma berberidis* (Lév.) Har. *Uredo cyclostoma* Lév.=*Cœoma cyclostoma* (Lév.) Har. *Æcidium fœniculi* Cast.=*Æcidium ferulæ* Roussel. *Æcidium glechomæ* Gaillard can not be distinguished from an *Æcidium* found by Brébison on *Teucrium scorodonia. Æcidium trifolii-repentis* Cast. is the *Æcidium* of *Uromyces trifolii* (Hedw.) Lév. *Æcidium scorzoneræ* Cast. belongs to *Puccinia tragopogonis* (Pers.) Cda. (E. A. S.)

969. HARIOT, P. **Sur quelques Urédinées.** <Bull. Soc. Mycol., France, vol. VII, Paris, Dec. 31, 1891, pp. 195–202.

The author has examined a large number of Montagne's species, and in this article gives notes and complete descriptions of many species. Gives the following notes on synonymy: *Æcidium scillinum* D. R. & Mont. does not seem to differ from the *Æcidium* of *Uromyces erythronii* and is equally like *Æ. asphodeli* Cast. *Uromyces sisyrinchii* Mont. is the uredospore state of *Puccinia sisyrinchii* Mont. *Uromyces placentula* Mont. was communicated by Berkeley under the name *Uredo placentula*, but is only the uredo of *Puccinia pruni* Pers. *Uredo pruni* Mont. can not be separated from *Puccinia pruni* Pers. *Uredo microcelis* Mont. is a poorly developed specimen of *Uromyces limonii* (DC.) Lév., and *Uredo statices* B. & C. (North Pacific expl. expd., No. 135) belongs to the same species. *Uredo planiscula* Mont. is the uredospore state of *Uromyces rumicis* (Schum.) Wint. *Uredo bellidis* D. R. & Mont. and a fungus in Montagne's herbarium under the name of *Æcidium purpurascens* D. R. and Mont. are both forms of *Puccinia hieracii* (Schum.) Mart. Besides these species from Montagne's herbarium the article also contains notes on some other Uredineæ studied by the author. *Uredo japonica* B. & C. (Pacific expd., No. 134) = *Uromyces japonicus* Berk. *Puccinia cardui* Plowright should be referred to *P. cnici-oleracei* Desmaz. (E. A. S.)

970. HARIOT, P. **Uromyces des légumineuses.** <Rev. Mycol., vol. XIV, Toulouse, Jan. 1, 1892, pp. 11–22.

A list of 35 species of Uromyces on Leguminosæ, with notes and in some cases full descriptions. The number of species as usually counted is reduced in some cases by uniting several species. The following changes are made: *Uromyces fabæ* (Pers.) DBy. = *Uromyces viciæ* Fckl., *U. lathyri* Thüm. on *Lathyrus pisiformis, sylvestris*, and *Vicia*. *Uredo longipes* Lasch. or *leguminosarum*, and *Uromyces ervi* West. *Uromyces trifolii* (Hedw.) Lév. = *Uredo fallens* Desm., *Uromyces cytisi* Thüm. on *Caraganum purpureum*, *Uredo caraganæ* Thüm. on *Caraganum arborescentem*, *Uromyces onobrychidis* Lév., *Uredo onobrychii* Desm., and *Æcidium elegans* B. & C. on *Trifolium carolinianum*. *Uromyces appendiculatus* (Pers.) Lk. = *Uredo leguminum* Desm., *Uromyces dolichi* Cke., *Æcidium candidum* Bonorden, *Cæoma apiculosum* Bonord. *Uromyces pisi* (Pers.) DBy. = *Uredo lathyri* Bellynck, *Uredo viciæ craccæ* Bellynck. *Uromyces striatus* Schr. = *Uromyces trifolii* Fckl. Fung. Rhen. No. 386. *Uromyces lespedezæ* (Schw.) Pk. = *U. macrosporus* B. & C.; *Uromyces solidus* B. & C. *Uromyces lupini* B. & C. = *Uromyces astragali* var. *lupini* B. & C. *Uredo lupini* B. &. C. This species is distinct from *Uromyces lupini* Sacc. and from *U. astragali*. *Uromyces astragali* (Opiz.) Sacc. includes as synonyms *U. oxytropidis* Kng. in Rab. F. Eur. No. 1793; *U. cytisi* Schr. in ibid No. 2671; *Uredo oxytropidis* Pk. Winter has united some species to *Uromyces genistæ-tinctoriæ*, which should be separated from it—*U. anthyllidis, U. anagyridis, U. ononidis, U. trigonellæ, Uromyces*, and *Uredo lupini* (not B. & C.)—which ought to be referred to the following species: *Uromyces astragali, U. punctatus, U. oxytropidis*, which belong to *U. astragali*. *Uromyces pteleacearum* Rab. F. Eur. No. 93 has the host wrongly named, and is *U. genistæ* on *Laburnum*. The following must be omitted from the synonyms of *U. genistæ-tinctoriæ*: *U. cytisi* Schroet. F. E. No. 2731; *U. cytisi* Thüm. M. V. No. 1728; *Uredo caraganæ* on *Carag. arborescens*, *Uromyces onobrychidis* Lev. *Uromyces anthyllidis* = *U. anagyridis* (Roussel) Roum.; *U. lupini* Sacc. (not B. & C.); *U. ononidis* Passer, in Rab. F. Eur. No. 1792; *U. trigonellæ* Passer in Thüm. H. Œcon. No. 118; *U. trigonellæ* Pat. *Uromyces minor* Schroet. should include *U. trifolii* (Wettstein) on *Trif. montanum* in Fl. Excicc. Austro-Hung. No. 1563. *Uredo hedysari* Thüm. M. V. No. 1932 on *Hedysarum setigerum*, from Siberia, does not belong to *Uromyces hedysari* (DC.) Fckl., but to *Uromyces astragali*. *Urom. haszlinskii* de Toni should be added to the synonyms of the latter. *Uromyces lapponicus* Lagerh. = *Æcidium astragali* Thüm. M. V. No. 1117; *Æ. astragali* Eriksson, F. par. Scand. No. 285; *Æ. astragali-alpini* Eriks., ibid.; *Æ. carneum*, de Lagerh.; *Æ. oxytropidis* Thüm. The following species are excluded: *U. mucunæ* Rab., *U. sphæropleus* Cke., *U. pseudarthriæ* Cke., *U. versatilis* Pk., *U. tepperianus* Sacc. (E. A. S.)

971. HISINGER, EDUARD. **Puccinia malvacearum, Mont. hunnen till Finland, 1890.** <Bot. Notiz. Lund, 1891, pp. 44–45.

Notes spread of species from Chili, where first discovered, in 1852, to various parts of Europe. Quotes Eriksson as reporting it in Aragonia in 1869, as appearing in Bordeaux in 1871, in England in 1873, as spreading through Germany to Austria, Italy, Holland, and Denmark, only appearing in Sweden in 1882, and not reaching the northern part before 1887. Finally (1890) reports it from Finland. (Theo. Holm.)

972. HOWELL, J. K. **The trimorphism of Uromyces trifolii (Alb. and Schw.), Wint.** <Proc. Am. Asso. Adv. Sci., vol. XXXIX, July, 1891, Salem, Mass., pp. 330–331.

Gives results of experiments, showing that the *Æcidium* growing on clover is a form of *Uromyces trifolii*. (See Nos. 151 and 209.) (J. F. J.)

973. LAGERHEIM, G. DE. **Om förekomsten af europeiska Uredinéer på Quito's högslätt.** <Bot. Notiser, Lund, 1891, pp. 63–66.

The author has found *Puccinia coronata* on specimens of *Avena*, the seeds of which had been introduced from Europe. Calls attention to the fact that none of the species of *Rhamnus*, said to be the bearers of the Æcidium form, have yet been observed in Ecuador. The only possible explanation of the occurrence of this *Puccinia* in Ecuador will therefore be to suppose that the Æcidium-form has been omitted entirely. Similar observations have been made by Plowright (The connection of wheat mildew (*Puccinia graminis* Pers.) with the Barberry-Æcidium (*A. berberidis* Gmel.), Records of the Woolhope Transactions, Hereford, 1887), who succeeded in infecting young plants of wheat directly with sporidia of *Puccinia graminis*. This last fungus has also been found in Ecuador, although the species of *Berberis* and *Mahonia*, upon which the Æcidium form is said to occur, are wanting. The author has found, however, an Æcidium upon *Berberis glauca*, but this seems to belong to a *Dicrchidium*, hitherto unknown, and occurring on the same *Berberis*. The author describes a new species, *Fusarium uredinis*, parasitic on the Uredo form of *Puccinia graminis*. (Theo. Holm.)

974. Lagerheim, G. de. Pucciniosira, Chrysospora, Alveolaria und Trichospora, vier neue Uredineen-Gattungen mit tremelloider Entwickelung. (Vorläufige Mittheilung). <Ber. d. deutsch. bot. Gesell., 9. Jahrg., heft 10, Berlin, Jan. 24, 1892, pp. 344–348.

Gives a preliminary notice of four interesting new genera of tremelloid *Uredineæ*. *Pucciniosira* resembles *Endophyllum*, but has two-celled smooth spores. Two species are described. *P. triumfettæ* on leaves of *T.* sp. in Equador and on *T. abutiloides* in Brazil has colorless spores, which have attached to them the empty intermediate cell and do not fall apart into two cells in germinating. Only teleutospores are described. The second species, *P. solani* on leaves of *Solanum* sp. in Equador, differs much from the first; the spores are produced in chains which adhere to each other laterally. The spores are orange yellow and in germinating fall apart into two cells. The intermediate cells disappear early in the development of the fungus and nothing can be seen of them when the spores are mature. Spermogonia and teleutospores occur. In a footnote it is mentioned that a *Leptopuccinia* occurs on *Cestrum*, and another on *Solanum* in Equador, making with *Pucciniosira* three tremelloid *Uredineæ* known on the family Solanaceæ, though none were previously known. *Chrysospora* has bright red sori containing teleutospores like *Puccinia* in structure. In germinating each cell divides into four segments, each of which produces a large sporidium on the end of a unicellular promycelium. The genus resembles, therefore, a *Coleosporium* in which the teleutospores become segmented just before germination. Spermogonia and teleutospores occur. A single species, *C. gynoxidis*, is described which occurs on leaves or occasionally on young shoots of *Gynoxis pulchella* DC. and *G. buxifolia* DC. in Equador. *Alveolaria* produces cylindric ringed columns consisting of a series of disk-like teleutospores which are composed of many prismatic cells. The cells have a smooth membrane. The spore disks ripen in basipetal order and are loosened in germination, which proceeds as in *Puccinia*. Only teleutospores are produced. Two species are described. The first, *A. cordiæ*, occurs on leaves of *Cordia* sp. in Equador and has spore-disks 120-150 μ wide and 40-50 μ high, consisting of 30 to 60 cells which have yellowish walls and colorless cell contents. The second, *A. andina*, occurs on a very different *Cordia* in Equador and has spore-disks 180-210 μ wide and about 70 μ high, composed of very numerous cells, which have bright orange-colored contents. *Trichospora* has filiform orange-yellow sori similar in structure to those of *Cronartium* and composed of more or less spool-shaped teleutospores and sterile cells. The membrane of the teleutospores is colorless and thickened at the ends; the contents are orange red. The sterile cells, which occur among the teleutospores, are very narrow and long and contain a reddish cell content. The germination of the teleutospores is very different from that of *Cronartium*. The young spores are unicellular, but when ripe are divided by three delicate septæ into four cells, each of which produced in germinating a unicellular promycelium with a single sporidium. One species, *T. tournefortiæ*, is described. It is very common in Equador on all parts of two species of *Tournefortia*. Both spermogonia and teleutospores are produced. The spermogonia are unusually large and have spermatia with red cell contents. (W. T. S.)

975. Magnus, P. Eine Bemerkung zu Uromyces excavatus (DC.) Magn. <Hedwigia, Bd. xxx, Dresden, Juli u. Aug., 1891, pp. 196–197.

States that the name of the fungus should be *Uromyces excavatus* (DC.) Magn., not *U. excavatus* (DC.) Berk. It is different from *U. excavata* (DC.) of Berkley and of Cooke, which is really *U. tuberculatus* Fckl. (W. T. S.)

976. Newcombe, F. C. Perennial mycelium of the fungus of blackberry rust. <Jour. Mycol., vol. vi, Washington, Jan. 6, 1891, p. 106, pl. v, vi.

Describes features presented by blackberry cane affected with rust, *Cæoma nitens*. Concludes mycelium to be perennial (see No. 822). (J. F. J.)

977. Pirotta, R. Sulla Puccinia gladioli Cast. e sulle Puccinie con parafisi. <Nuovo Gior. Bot. Ital. (Bull. d. Soc.), vol. xxiii, Firenze, 5 Ottobre, 1891, pp. 578–581.

Records *Puccinia gladioli* Cast. on *Romulea ramiflora* Ten., a new host, as possessing paraphyses. Refers to omission of the species from Schroeter and Winter, and imperfect description of geographical distribution by Saccardo & Celotti, giving corrections and full synonomy. Discusses presence of paraphyses in Pucineæ, preferring to consider them as constituting secondary characters only. Adds list of species with paraphyses as follows: *P. anemones-virginianæ* Schw., *P. gladioli* Cast., *P. virgaureæ*, *P. allii*, *P. polygoni-amphibii* Pers., *P. sonchi* Rab., *P. pruni spinosæ* Pers., *P. rubigo-vera*, *P. cordæ* Bagn., *P. gibberosa* Lagerh. (D. G. F.)

(See also Nos. 692, 723, 736, 742, 764, 864, 873, 895, 923, 925, 979, and 998.)

VII.—USTILAGINEÆ.

978. Ellis, J. B., & Anderson, F. W. A new Ustilago from Florida. <Jour. Mycol., vol. vi, Washington, Jan. 6, 1891, pp. 116–117.

Describe new species on *Heteropogon melanocarpa* as *Ustilago nealii*. (J. F. J.)

979. Pirotta [R.]. [Due funghi non comuni in Italia.] <Nuovo Gior. Bot. Ital. (Bull. d. Soc.), vol. xxiii, Firenze, 6 April, 1891, p. 296.

Notice by secretary of society that Pirotta illustrated briefly before the Society *Ustilago panici-miliacei* on millet, and *Puccinia grisea* on *Globularia vulgaris*, noting them as rare in Italy. (D. G. F.)

980. PIROTTA, R. **Sull'Urocystis primulicola Magnus in Italia.** <Nuovo Gior. Bot. Ital. (Bull. d. Soc.), vol. XXIII, Firenze, 1 Luglio, 1891, p. 502.

Calls attention to error in Godfrin's article in Bull. Soc. Bot., France, t. XXXVIII, 1891, p. 68, in which the author's paper in N. Gior. Bot. Ital., 13, 1881, p. 235, is given as authority for presence of the fungus in Italy, when in fact the material referred to in the paper was sent to Pirotta from near Gotha by DeBary. Adds that the fungus has been recorded by Cocconi and Morini in 1886 from near Bologna, and published in Mem. Acad. Sc. di Bologna, ser. IV, t. VI, p. 373. (D. G. F.)

(See also Nos. 692, 698, 716, 723, 877, 923, 957, and 964.)

VIII.—ASCOMYCETES.

a.—Gymnoasci.

981. MASSALONGO, C. **Sulla scoperta in Italia della Taphrina epiphylla Sadebeck.** <Nuovo Gior. Bot. Ital. (Bull. d. Soc.), vol. XXIII, Firenze, 1 Luglio, 1891, pp. 325–327.

Reports the discovery of the species in the province of Verona near Bolca, and gives synonomy of the species, referring to Sadebeck's work on irritant action of parasite on host. (D. G. F.)

b.—Perisporiaceæ.

(See No. 764.)

c.—Sphæriaceæ.

982. [Anon.] **The Chinese insect-fungus drug.** <Insect Life, vol. IV, Washington, Dec., 1891, pp. 216–218, fig. 2.

Refers to *Cordyceps chinensis*, a fungus infesting grubs and used in China as a medicine. Quotes account given by A. C. Jones, U. S. consul at Chinkiang, China. (J. F. J.)

983. FAIRMAN, C. E. **Observations on the development of some fenestrate sporidia.** <Jour. Mycol., vol. VI, Washington, May 14, 1890, pp. 29–31.

Describes development of sporidia in *Fenestella amorpha*, *Patellaria fenestrata*, and *Camarosporium subfenestratum*. (J. F. J.)

984. HALSTED, B. D. **Ergot and ergotism.** <Cult. and Country Gent., vol. LVI, Albany, Oct. 29, 1891, p. 871, fig. 1.

Gives popular exposition of the life history of *Claviceps pupurea* Tul., with methods of prevention of ergotism by careful cutting of suspected grain while in the bloom. (D. G. F.)

985. MASSEE, GEORGE. **A new Cordyceps.** <Ann. of Bot., vol. V, London, Nov., 1891, pp. 510–511, fig. 5.

Describes *C. sherringii*, n. sp., parasitic on an ant from Granada, S. America. Discusses relation of species to others in same genus and in *Oomyces*, *Epichloe*, and *Claviceps*. Mentions particularly *Cordyceps robertsii* from New Zealand. (J. F. J.)

986. REHM. **Die Discomyceten-Gattung Ahlesia Fuckel und die Pyrenomyceten-Gattung Thelocarpon Nyl.** <Hedwigia, Bd. XXX, Dresden, Jan. u. Feb., 1891, pp. 1–12.

Ahlesia is according to the author not a *Discomycete*, as Fuckel thought, but a hypocreaceous *Pyrenomycete* closely allied to *Chilonectria* and *Aponectria* (which in his estimation should not be separated). The genus *Thelocarpon* of Nylander placed heretofore in pyrenocarpous lichens is really the same as *Ahlesia*, and being an older name must be adopted and placed in Hypocreaceæ. The green gonidia found often in the base of the perithecia are looked upon as algæ, either living in symbiose with the fungus or accidentally present. On pages 4–12 is given a descriptive monograph of the 16 known species of *Thelocarpon*. *Ahlesia lichenicola* Fuckel is placed in the genus for the first time as *T. ahlesii* Rehm. (W. T. S.)

987. STARBÄCK, K. **Bidrag till Kännedomen om Sveriges ascomycetflora.** <Bihang till Kgl. Svenska Vetenskaps Akad. Handlingar, vol. XVI, Afdelning 3, 1891, Stockholm, pp. 1–15, pl. 1.

The following are described and figured as new: *Diaporthe rehmiana* on *Ulmus montana*; *Leptosphæria lasiosphærioides* on *Aconitum lycoctonum*; *Herpotrichia mucilaginosa* on *Juniperus communis*; *Cryptoderis oligotheca* on *Thalictrum alpinum*; *Sphærulina dryadis* on *Dryas octopetala*; *Starbäckia* n. gen.; *S. pseudotriblidioides* on pine wood. (Th. Holm.)

(See also Nos. 736, 740, 753, 764, and 769.)

d.—Discomycetes.

988. BOUDIER, EM. **Description de trois nouvelles espèces de Pezizes de France de la section des Operculées.** <Bull. de la Soc. Mycol., France, vol. VII, Paris, Dec. 31, 1891, pp. 214–217, pl. 1 (XV).

Describes *Disciotis maturescens*, *Galactinia michelii*, and *Sepultaria nicœensis*. Adds notes as to habitats, etc. (E. A. S.)

989. OUDEMANS, C. A. J. A. **Phacidium pusillum Libert.** <Hedwigia. Bd. xxx, Dresden, Sept. u. Oct., 1881, pp. 248–250.

The author found specimens and investigated them in the fresh condition in the summer of 1891. As a result of his studies he amends and completes Libert's description and corrects some statements of Roumeguère and Saccardo regarding the species. (W. T. S.)

(See also Nos. 950 and 986.)

IX.—IMPERFECT AND UNCLASSIFIED FORMS.

a.—Hyphomycetes and Stilbeæ.

990. ATKINSON, GEO. **Some Cercosporæ from Alabama.** <Jour. Elisha Mitchell Scien. Soc., vol. VIII, pt. 2, Feb. 24, 1892 [separate pp. 36].

Discusses the position of *Cercospora* in classification and mentions the forms under which it is known. Gives a brief sketch of life history of genus and notes paucity of knowledge in relation to complete life history of many species. Gives description of 79 species, with a few notes on synonomy and describes the following as new: *Cercospora tephrosiæ* on *Tephrosia hispidula; C. truncatella* on *Passiflora incarnata; C. agrostidis* on *Agrostis* sp.; *C. avicularis* Wint., var. *sagittati*, on *Polygonum sagittatum; C. anthelmintica* on *Chenopodium ambrosioides* var. *anthelminticum; C. jussiææ* on species of *Jussiæa; C. fusimaculans* on *Panicum dichotomum; C. setariæ* on *Setaria glauca; C. asterata* on *Aster* sp.?; *C. richardiæcola* on *Richardia africana; C. alabamensis* on *Ipomœa purpurea; C. flagellifera* on *Galactia pilosa; C. papillosa* on *Verbena* cult.; *C. solanicola* on *Solanum tuberosum; C. ludwigiæ* on *Ludwigia alternifolia; C. virginianæ* on *Diodia virginiana; C. crinospora* on *Rhyncospora glomerata; C. atromarginalis* on *Solanum nigrum; C. tropæoli* on *Tropæolum* cult.; *C. tesselata* on *Eleusine ægyptica; C. seriata* on *Sporobolus asper; C. althæina*, var. *modiolæ*, on *Modiola multifida; C. clitoriæ* on *Clitoria mariana; C. diospyri*, var. *ferruginosa; C. jatrophæ* on *Jatropha stimulosa; C. macroguttata* on *Chrysopsis graminifolia; C. pinnulæcola* on *Cassia nictitans; C. erythrogena* on *Rhexia mariana*, etc.; *C. rigospora* on *Solanum nigrum* (?); *C. catenospora* on *Sambucus canadensis*, and *C. erechtites* on *Erechtites hieracifolia*. (J. F. J.)

991. MACMILLAN, C. **Note on a Minnesota species of Isaria and an attendant Pachybasium.** <Jour. Mycol., vol. VI, Washington, Sept. 10, 1890, pp. 75–76.

Describes features presented by *Isaria sphingum*, parasitic on a tussock moth, and *Pachybasium hamatum* (?), which appeared in a gelatin culture tube. Queries if the latter be not a form of the *Isaria*. (J. F. J.)

992. MASSEE, GEORGE. **A new genus of Tuberculariеæ.** <Ann. of Bot., vol. V, London, Nov., 1891, p. 509, fig. 1.

Describes *Hobsonia*, n. gen. Berk., in herb., with n. sp. *H. gigaspora* Berk. in herb. [The figure is called *H. macrospora*.] From Venezuela. (J. F. J.)

(See also, Nos. 714, 716, 742. 747, 756, 764, and 903.)

b.—Sphæropsideæ and Melanconeæ.

993. CUBONI, G. **Diagnose di una nuova specie di fungo excipulaceo.** <Nuovo Gior. Bot. Ital. (Bull. d. Soc.), vol. XXIII, Firenze, 5 Ottobre, 1891, p. 577.

Describes new genus and new species on decorticated wood of *Morus alba, Phæodiscula celottii*, in honor of collector. Thinks genus should form a new section of the *Phæosporeæ*. (D. G. F.)

994. ELLIS, J. B., and EVERHART, B. M. **Leptothyrium periclymeni, Desm.** <Jour. Mycol., vol. VI, Washington, Jan. 6, 1891, p. 116.

Notes occurrence of species on *Lonicera* from Ontario and proposes to call it *Leptothyrium perilcymeni*, var. *americanum*. (J. F. J.)

995. MARTELLI [U]. **[Alcuni funghi che attacano le olive.]** <Nuovo Gior. Bot. Ital. (Bull. d. Soc.), vol. XXIII, Firenze, April 6, 1891, p. 324.

Report of secretary of note presented to the society in regard to a new *Phoma* on olives likely to prove disastrous, which he proposes to call *P. pallens*, although reserving the description for a future meeting, together with that of an associated form, possibly the spermogonial form of the *Phoma*. (D. G. F.)

(See also, Nos. 716, 732, 744, 761, and 779.)

c.—Miscellaneous.

996. MUELLER, Dr. J. **Critique de "l'Étude" du Docteur Wainio.** <Rev. Mycol., vol. XIV, Toulouse, Jan. 1, 1892, pp. 33–40.

An article written at the request of the editor of the Revue for the purpose of discussing the system of classification proposed by Dr. Wainio in an article on "The natural classification and morphology of the Lichens of Brazil." The author takes issue with Dr. Wainio on the main points of the original article. He rejects the theory of symbiosis, the definition of a lichen, and the characters used as a basis of classification. (E. A. S.)

997. STANLEY-BROWN, J. **Bernardinite: Is it a mineral or a fungus?** <Am. Jour. Sci., 3d ser., vol. XLII, New Haven, July, 1891, pp. 46–50.

Gives an account of the "mineral resin" described by Silliman in 1879. Gives analysis and general description of a specimen stated by Ellis to be *Polyporus officinalis* Fr. Found on *Pinus strobus* in various localities of the United States. (J. F. J.)

(See also, Nos. 654, 716, 832, 942, 943, and 944.)

G.—MORPHOLOGY AND CLASSIFICATION OF BACTERIA.

(See Nos. 720, 745, 886, and 933.)

H.—MORPHOLOGY AND CLASSIFICATION OF MYXOMYCETES.

(See Nos. 695, 716, and 855.)

I.—EXSICCATÆ.

998. PAZSCHKE, O., **Rabenhorst–Winter. Fungi Europæi et extraeuropæi. Cent. 38. Cura Dr. O. Pazschke.** <Hedwigia, Bd. XXX, Dresden, Juli u. August, 1891, pp. 197–200.

Gives a list of the species in the 38th century of this exsiccata and reprints a note on 3704, *Urocystis hypoxidis* Thaxter, from Brazil, and the descriptions of the following new species: *Puccinia pithecocteni* II and III on leaves of *Pithecoctenum* Brazil; *Uromyces dietelianus* on leaves of *Bauhinia (grandiflora?)* Brazil; *Uredo celtidis* on leaves of *Celtis*, Brazil; *Dichomera elæagni* Karst. on dead branches of *Elæagnus macrophylla*, Finland. (W. T. S.)

999. REHM. **Ascomyceten fasc. xxi.** <Hedwigia, Bd. XXX, Dresden, 1891, Sept. u. Oct., 1891, pp. 250–262.

This exsiccata after a long pause necessitated by the pressure of other work has been resumed and will be continued. In this article the names of the species in fasc. XXI, with synonomy and often with critical notes, are reprinted apparently as given on the labels. This fascicle includes Nos. 1001-1050 and 146b., 682b., 69b, c., 444b., 8b. The following new species are described: *Pezizella dilutelloides* on decayed petioles of *Robinia pseudacacia* near Berlin; *Tryblidaria subtropica* (Wint.) (=*Blitrydium subtropicum* Winter Hedw., 1885, p. 263); *Cryptodiscus pusillus* (Lib.) (=*Phacidium pusillum* Libert Pl. arden, 268); *Phyllachora lagerheimiana* on living leaves of *Ilex scopulus* Panecillo, near Quito; *Strickeria tingens* Wagelin. in litt. on decorticated wood of *Fraxinus*, Switzerland; *Meliola lagerheimii* Gaillard on living leaves of *Ilex scopulorum*, Quito; *Sphærotheca gigantiascus* (Sorok. et Thüm.) Bäumler (= *Erysiphe gigantiascus* Sorok. et Thüm. Mycoth. in Sched.) on *Euphorbia palustris*, Pressburg, Hungary. (W. T. S.)

J.—TECHNIQUE.

1000. BOURQUELOT, EM. **Sur un artifice facilitant la recherche du tréhalose dans les champignons.** <Bull. Soc. Mycol., France, vol. VII, Paris, Dec. 31, 1891, pp. 208–209.

Gives a method of hastening the crystallization of trehalose by inserting in the solution a glass plate previously rubbed with a crystal of trehalose. The crystals collect about the portion of the glass thus prepared. Later they can be detached, and by scattering them crystallization will be provoked everywhere in the liquid. A footnote gives the method of first disposing of the mannite in the same solution. (E. A. S.)

1001. GAILLARD, A. **Note sur un procéde pour l'observation des champignons epiphytes.** <Bull. Soc. Mycol., France, vol. VII, Paris, Dec. 31, pp. 232–234.

Gives a method of observing the aërial parts of fungi by means of running over them a drop of collodion in solution and afterward transferring on the slide to glycerin jelly. By this means the fungus can be examined in its natural position. (E. A. S.)

1002. WAITE, M. B. **[Directions for collecting] fungi.** <U. S. Nat. Museum, Bull. No. 39, Washington, 1891, pp. 24–27.

Gives general directions for making collections of saprophytic and parasitic fungi. (J. F. J.)

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V. P. 43.

U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF VEGETABLE PATHOLOGY.

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PUBLICATIONS OF THE DIVISION OF VEGETABLE PATHOLOGY.

The Division of Vegetable Pathology, formerly a section of the Division of Botany, became a separate organization by act of Congress approved July 14, 1890. Since that date its bulletins have been numbered independently and in a separate series, but the following list includes the publications of the Division under its former as well as under its present organization. Nos. 1, 3, 4, and 6, omitted from the series of bulletins published by the Section of Vegetable Pathology, are publications of the Division of Botany, not relating to vegetable pathology. Only those documents marked with an asterisk are still on hand for distribution.

SECTION OF VEGETABLE PATHOLOGY, DIVISION OF BOTANY.

Journal of Mycology:

Vol. V, Nos. 1, 2, 3, 4. Pp. 249, pl. 14. 1889-'90.

Vol. VI, No. 1.* Pp. 44, pl. 2. 1891.

Bulletins:

No. 2. Fungous Diseases of the Grapevine. Pp. 136, pl. 7. 1886.

No. 5. Report on the Experiments made in 1887 in the Treatment of Downy Mildew and Black Rot of the Grape. Pp. 113. 1888.

No. 7.* Black Rot. Pp. 29, pl. 1. 1888.

No. 8.* A Record of some of the Work of the Division. Pp. 69. 1889.

No. 9. Peach Yellows: A Preliminary Report. Pp. 254, pl. 36, maps and diagrams 9. 1888.

No. 10. Report on the Experiments made in 1888 in the Treatment of Downy Mildew and Black Rot of the Grape. Pp. 61, pls. 2. 1889.

No. 11. Report on the Experiments made in 1839 in the Treatment of Fungous Diseases of Plants. Pp. 119, pl. 8. 1890.

Circulars:

No. 1. Treatment of Downy Mildew and Black Rot of the Grape. Pp. 3. 1885.

No. 2. Grapevine Mildew and Black Rot. Pp. 3. 1885.

No. 3. Treatment of Grape Rot and Mildew. Pp. 2. 1886.

No. 4. Treatment of the Potato and Tomato for Blight and Rot. Pp. 3. 1886.

No. 5. Fungicides or Remedies for Plant Diseases. Pp. 10. 1888.

No. 6.* Treatment of Black Rot of the Grape. Pp. 3. 1888.

No. 7.* Grapevine Diseases. Pp. 4. 1889.

No. 8. Experiments in the Treatment of Pear Leaf Blight and Apple Powdery Mildew. Pp. 11. 1889.

No. 9.* Root Rot of Cotton. Pp. 4. 1889.

DIVISION OF VEGETABLE PATHOLOGY.

Journal of Mycology:

Vol. VI. Nos. 2*, 3*, 4.* Pp. 163, pl. 16. 1890-'91.

Vol. VII, Nos. 1, 2, 3. Pp. 331, pl. 31. 1891-'93.

Bulletins:

No. 1.* Additional Evidence on the Communicability of Peach Yellows and Peach Rosette. Pp. 65, pl. 39. 1891.

No. 2.* The California Vine Disease. Pp. 222, pl. 27. 1892.

No. 3. Report on the Experiments made in 1891 in the Treatment of Plant Diseases. Pp. 76, pl. 8. 1892.

No. 4. Experiments with Fertilizers for the Prevention and Cure of Peach Yellows, 1889-'92. Pp. 197, pls. 33. 1893.

No. 5.* The Pollination of Pear Flowers. Pp. 110, pls. 12. 1894.

No. 6. Bordeaux Mixture as a Fungicide.

No. 7. The Effect of Spraying with Fungicides on the Growth of Nursery Stock.

Farmers' Bulletins:

No. 4.* Fungous Diseases of the Grape and their Treatment. Pp. 12. 1891.

No. 5.* Treatment of Smuts of Oats and Wheat. Pp. 8, pl. 1. 1892.

No. 7.* Spraying Fruits for Insect Pests and Fungous Diseases. Pp. 20. 1892.

No. 15.* Some Destructive Potato Diseases. Pp. 8, figs. 3. 1894.

No. 17.* Peach Yellows and Peach Rosette. Pp. 20, figs. 7. 1894.

Circulars:

No. 10.* Treatment of Nursery Stock for Leaf Blight and Powdery Mildew. Pp. 8, figs. 2. 1891.

No. 11.* Inquiry on Grape Diseases and their Treatment. P. 1. 1891.

No. 12.* Inquiry on Rust of Cereals. P. 1. 1891.

No. 13.* Inquiry on Peach Leaf Curl. Pp. 3. 1893.

No. 14.* Inquiry on Rusts of Cereals. Pp. 3. 1894.

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